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NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical Chemistry

Refer also to abstracts 25833, 25935, 26070, 26288, and 27527.

25765 (AERE-M-1844) THE DETERMINATION OF ^{35}S IN URINE BY LIQUID SCINTILLATION COUNTING. Sandalls, F. J. (Atomic Energy Research Establishment, Harwell (England)). Mar. 1967. 12p. Dep. CFSTI. UK 1s. 9d.

A rapid and sensitive method is described. A 10-ml sample of urine with added sulphate carrier is oxidized with Benedict's reagent and ^{35}S precipitated as barium sulphate. An overall recovery of 95% is obtained, and the counting efficiency is 75% with a Packard Tricarb 3214 counter. The minimum level of detection corresponds to approximately 340 pCi/1400 ml of urine, which is lower than the investigation level by a factor of about 10^4. (auth)

25766 (AERE-R-5406) THE DETERMINATION OF RADIOIODINE IN HARWELL EFFLUENT. Loveridge, B. A.; Gordon, M. S. (Atomic Energy Research Establishment, Harwell (England)). Mar. 1967. 14p. Dep. CFSTI. UK 2s. 6d.

Iodine carrier is added to the effluent and extracted together with the radioiodine into organic solvents after oxidation and reduction to ensure complete radiochemical exchange. The radioiodine is counted in a liquid scintillation coincidence counter, and the recovery of the carrier measured by photometry. Decontamination from other radionuclides, including radiobromine, exceeds 10^5. (auth)

25767 (EUR-3161.f(Vol.1)) ETUDE DES POSSIBILITES D'UTILISATION INDUSTRIELLE DE L'ANALYSE PAR ACTIVATION POUR LE DOSAGE DE L'OXYGENE ET EVENTUELLEMENT DE L'AZOTE ET DE L'HYDROGENE DANS LES ACIERS. PREMIERE PARTIE. RAPPORT BIBLIOGRAPHIQUE. **(Investigations on the Industrial Application Possibilities of Activation Analysis for the Determination of Oxygen and Eventually of Nitrogen and Hydrogen in Steel. Part I. Bibliographical Report). Stoll, N.; Wagner, A.; Goedert, L.** (Acieries Reunies de Burbach-Eich-Dudelange S. A., Luxembourg). Nov. 1966. 48p. (In French). Dep.

Various nonnuclear methods used or being developed for the determination of oxygen, nitrogen, and hydrogen in steel are reviewed. The nuclear reactions that are best suited for the determination of these three elements are considered. The irradiation means suited for use on an industrial scale for the determination of these three elements are discussed and the methods for measuring the induced activity, the methods for neutron flux monitoring, and the sample transfer systems are described. The calibration methods are reviewed and the analytical performances of neutron activation analysis are discussed. It was concluded that among the three elements under consideration solely the oxygen can be determined in steel on an industrial scale by activation. (auth)

25768 (EUR-3161.f(Vol.2)) ETUDE DES POSSIBILITES D'UTILISATION INDUSTRIELLE DE L'ANALYSE PAR ACTIVATION POUR LE DOSAGE DE L'OXYGENE ET EVENTUELLEMENT DE L'AZOTE ET DE L'HYDROGENE DANS LES ACIERS. DEUXIEME PARTIE. DESCRIPTION ET RESULTATS DES ESSAIS. **(Investigations on the Industrial Application Possibilities of Activation Analysis for the Determination of Oxygen and Eventually of Nitrogen and Hydrogen in Steel. Part II. Description and Results of the Tests). Stoll, N.; Wagner, A.; Goedert, L.** (Acieries Reunies de Burbach-Eich-Dudelange S. A., Luxembourg). Nov. 1966. 69p. (In French). Dep.

Sampling, machining, and selecting the steel samples are discussed. The selection of the analytical methods and of the laboratories retained for the investigations along with the working program followed are described. The apparatus for the determination of oxygen and conditions for carrying out the tests are considered. All the results obtained during the tests are listed. (auth)

25769 (EUR-3161.f(Vol.3)) ETUDE DES POSSIBILITES D'UTILISATION INDUSTRIELLE DE L'ANALYSE PAR ACTIVATION POUR LE DOSAGE DE L'OXYGENE ET EVENTUELLEMENT DE L'AZOTE ET DE L'HYDROGENE DANS LES ACIERS. TROISIEME PARTIE. DISCUSSION DES ESSAIS ET CONCLUSIONS A TIRER DE L'ETUDE. **(Investigations on the Industrial Application Possibilities of Activation Analysis for the Determination of Oxygen and Eventually of Nitrogen and Hydrogen in Steel. Part III. Discussion of the Tests and Conclusions to be Deduced From the Investigation). Stoll, N.; Wagner, A.; Goedert, L.** (Acieties Reunies de Burbach-Eich-Dudelange S. A., Luxembourg). Nov. 1966. 28p. (In French). Dep.

The analytical results obtained and the advantages and disadvantages of neutron activation and of conventional equipment tested are considered. Installation costs for various neutron activation equipment are indicated and the cost price of one oxygen determination by neutron activation and by conventional means was calculated as a function of the number of determinations performed. It was concluded that neutron activation analysis is capable of determining the oxygen content in steel during productions with rapidity and the accuracy necessary to enable the steel makers to choose the deoxidation means to be added as a function of this oxygen content. (auth)

25770 (JAERI-1125) CHEMICAL ANALYSIS PROCEDURES FOR JPDR LABORATORY. **Ishiwatari, Nasumi** (Japan Atomic Energy Research Inst., Tokyo). Sept. 1966. 18p. (In Japanese). Dep.

The nuclear species and chemical compounds for which the improved procedures were applied at JPDR include the following: aluminum, boric acid, chloride, chromate, chromium, chromium-51, cobalt-58 and -60, copper, copper-64, dissolved oxygen, fluorine-18, iodine 131 through 135, iron, iron-59, manganese, manganese-54 and -56, molybdenum, molybdenum-99, nickel, silica, sodium-24, tungsten-187, turbidity and zinc-65. (auth)

25771 (LA-DC-8507) SPECTROCHEMICAL DETERMINATION OF IMPURITIES IN HIGH-PURITY PLUTONIUM BY ANION-EXCHANGE SEPARATION AND GRAPHITE-SPARK EXCITATION. **Murphy, James F.; Phelps, Robert T.** (Los Alamos Scientific Lab., N. Mex.). [1964]. Contract W-7405-eng-36. 21p. (CONF-670518-1). Dep. CFSTI.

From 18th Annual Mid-America Symposium on Spectroscopy, Chicago, Ill.

Limits of detection with respect to those obtained by routine spectrochemical methods were improved and a greater number of elements (29) were determined in high-purity Pu by an anion exchange-spectrochemical method. In the method developed, Pu(IV) is adsorbed from 7.5 $\underline{M}$ HNO_3 onto Bio-Rad 1 × 8 resin and the non-adsorbed elements washed from the resin column with HNO_3 of the same molarity. After adding indium internal standard and gallium matrix, the solutions containing the impurity elements are evaporated on the ends of graphite electrodes and excited by high-voltage spark. The characteristic spectra are photographed and evaluated in terms of concentration by conventional spectrographic practices. (P.C.H.)

25772 (TRG-Report–1227) STUDY OF NON-METALLIC IMPURITIES IN SODIUM BY AMALGAMATION COUPLED WITH MASS SPECTROMETRY. Grundy, B. R.; Hamer, A. N. (United Kingdom Atomic Energy Authority, Risley (England). Reactor Group). Jan. 16, 1967. 19p. (CONF-660933–6). Dep. CFSTI. UK 2s. 6d.

From 10th Conference on Analytical Chemistry in Nuclear Technology, Gatlinburg, Tenn.

A search has commenced for the presence of non-metallic impurities in sodium samples taken from test rigs, by combining an amalgamation technique with mass spectrometry. The object is to establish the chemical form of certain impurity elements (particularly carbon) which are known to be present from the results of elemental analysis. Samples of sodium were removed from test rigs by dip samplers, which were protected by argon-filled dry boxes fitted with vacuum locks. Sodium metal was then removed by amalgamation, and the insoluble residues were hydrolysed in two stages by distilled water and dilute sulphuric acid. The gases released during the amalgamation process, and in each hydrolytic step, were collected separately and analysed by mass spectrometry. Preliminary results indicate that, in addition to hydrogen and argon, the gases collected contained carbon dioxide and a mixture of hydrocarbons, in which methane, ethane, ethylene and acetylene were identified. From the results some inferences may be drawn about the origin of these gases in the sodium sample. The method is sufficiently sensitive to detect individual impurities at levels in the order of 0.1 ppM, although some variation is caused by overlap in the mass spectra for particular species. The amounts of hydrogen collected by this procedure agreed with predictions which were based on routine measurements involving diffusion through welded iron cans. In all cases the observed hydrogen concentrations in sodium samples drawn from rigs which had been cold-trapped for long periods at stable temperatures were appreciably greater than those expected from published solubility data. Reasonable agreement was also obtained between the amounts of carbon dioxide collected and the level of sodium carbonate in the rigs, measured by an alternative procedure. (auth)

25773 (UJV–1681) CHEMICKA ANALYSA URANU S NIZKYM OBSAHEM ZELEZA A HLINIKU. (Chemical Analysis of Uranium Alloyed with Iron and Aluminum). Zocek, J. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). Nov. 1966. 28p. (In Czech). Dep.

The spectrophotometric determination of a small amount of Fe and Al in low-alloyed uranium alloys is described. Two variations of the analysis were developed: the simultaneous determination of both elements and determination of each element separately. Furthermore the analysis of the master U–Al alloy used for alloying is described. This process is used also to test standard Al solutions. To eliminate elements disturbing the determination of Al when hydroxyquinoline is used, 2-methyl-8-hydroxyquinoline was tested. (auth)

25774 APPARENT ORGANOBROMINE COMPOUNDS IN HIGHER PLANTS BY NEUTRON-ACTIVATION ANALYSIS. Gunther, F. A. (Univ. of California, Riverside); Spenger, R. E. Bull. Environ. Contam. Toxicol., 1: 121-6(July-Aug. 1966).

Techniques are described whereby organobromine compounds in plant parts never exposed to pesticides are demonstrable by neutron-activation analysis. Finely ground plant parts were dehydrated with Cl- and Br-free isopropyl alcohol then coextracted with Cl- and Br-free n-hexane; the hexane extract was washed free of isopropyl alcohol and of inorganic halides with Cl- and Br-free distilled water, concentrated about 50 to 1, then thermal-neutron activated and scanned, after a suitable decay interval, for 37-min ^{38}Cl and for both 18-min ^{80}Br and 36-hr ^{82}Br by γ spectrometry. Typical results from plants and some of their parts grown on land never exposed to a pesticide are shown. Neutron-activation analysis for Br is highly specific and reproducible so there was little doubt that this element was actually present in the amounts indicated. Whether it was actually organically bound bromine is discussed. Depending on measuring technique (e.g., direct potentiometric analysis after combustion) traces of Br from either organic or inorganic Br could result in a large error in Cl analysis, as with the cucumber seeds; however, the data do not consistently demonstrate such a probability. (BBB)

25775 PHOTOCOLORIMETRIC ANALYSIS OF U(VI) IN METALLIC LEAD. Kovalenko, P. N.; Shchemeleva, G. G.; Sokolova, L. S. (Rostov State Univ., Rostov-on-Don, USSR). Zavodsk. Lab., 33: 287-8(1967). (In Russian).

A photocolorimetric method for uranium determination based on the formation of a ternary uranium benzoate complex with Crystal Violet is described. A solution of 5% tributyl phosphate in toluene was used as extraction agent. The method was used for simultaneous separation and determination of uranium micro-impurities in lead. (tr-auth)

25776 DETERMINATION OF THE RELATIVE ABUNDANCE OF DEUTERIUM IN WATER BY MEASUREMENT OF ELECTRIC CONDUCTIVITY. Mauersberger, K.; Wetzel, K. (Deutsche Akademie der Wissenschaften, Berlin. Institut fuer Stabile Isotope, Leipzig). Z. Anal. Chem., 227: 409-15(1967). (In German).

A simple and precise method is described for determination of the deuterium content of water by conductivity measurements. It is based on isotope effects in ionic mobilities and in the degree of dissociation of weak electrolytes. An accuracy of ±0.02 at. % D is reached over the whole range. Therefore, precision analyses can be carried out, especially in the case of higher abundances of deuterium. By means of a special flow method the sample required amounts to only 100 mg of water. (auth)

25777 MICROANALYSIS OF FLUORINE IN ZIRCALOY BY THE USE OF THE ^{19}F(p,$\alpha\gamma$)^{16}O REACTION. Moeller, E.; Starfelt, N. (Aktiebolaget Atomenergi, Studsvik, Sweden). Nucl. Instrum. Methods, 50: 225-8(1967).

A method of determining fluorine contamination on and below the surface of Zircaloy by means of proton irradiation using a Van de Graaff accelerator and the detection of prompt gamma radiation from the ^{19}F(p,$\alpha\gamma$)^{16}O reaction was studied. Formulas for deriving depth distributions of impurities from the measured counting rate were derived. The influence of energy straggling on the depth resolution was studied. Both the total amount and the depth distribution were measured on samples which have undergone different treatments. Because of the high yield from the reaction used, a quantity of fluorine less than 0.01 μg/cm^2 can be detected by this method. (auth)

25778 MICROANALYSIS OF LIGHT ELEMENTS BY MEANS OF (d,n) REACTIONS. Moeller, E.; Nilsson, L.; Starfelt, N. (Aktiebolaget Atomenergi, Studsvik, Sweden). Nucl. Instrum. Methods, 50: 270-6(1967).

A method of determining impurities of carbon, nitrogen, and oxygen on and below steel surfaces by means of (d,n) reactions has been developed. The steel samples were irradiated by 3-MeV deuterons from a Van de Graaff accelerator and the spectra of the neutrons emitted in (d,n) reactions in the impurities were measured. These spectra contain information about the amount and the depth distribution of the impurities. The sensitivity was 0.1 μg/cm^2 and the depth resolution 4500 Å. Both these figures can be improved considerably. (auth)

25779 MONTE CARLO STUDY OF A METHOD FOR LUNAR (SURFACE) ANALYSIS BASED ON SPECTROSCOPY OF GAMMA RAYS FOLLOWING 14-MeV PULSED-NEUTRON BOMBARDMENT. Leimdorfer, M.; Boughner, R. T. (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. Nucl. Instrum. Methods, 50: 302-8(1967). (ORNL-P-2151).

In an investigation of the feasibility of analyzing the surface of the moon by gamma-ray spectroscopy techniques, Monte Carlo calculations were performed to estimate the spectral intensities of neutron-induced photons leaking from the moon surface during various time intervals following a burst of 14-MeV neutrons onto the surface. Four sets of calculations were done, all based on the lunar surface composition corresponding to an average composition of chondritic meteorites given by Urey and Craig, with varying amounts of carbon and hydrogen (or deuterium) added. The four spectra for the time interval 0 to 10^{-6} s following the burst are all essentially the same, clearly showing the inelastic de-excitation gamma rays from O, Si, Mg, and Fe and also from C when that element was present. The spectra for later time intervals (10^{-6}–10^{-5} s; 10^{-5}–10^{-4} s, and 10^{-4}–10^{-3} s) are predominantly capture spectra dominated by iron capture gamma lines at 6.0 and 7.63 MeV and by the 2.23-MeV hydrogen capture gamma line when hydrogen was present. An examination of all the spectra indicates that, providing proper calibrations are made, the abundances of the various isotopes present on the lunar surface can be determined by gamma-ray spectroscopy techniques. (auth)

25780 TRITIUM AND ^{14}C BY OXYGEN FLASK COMBUSTION. Davidson, Jack D.; Oliverio, Vincent T. (National Cancer Inst., Bethesda, Md.). Atomlight, No. 60, 1-10(May 1967).

A technique requiring a minimum of specialized or expensive equipment and effort is presented for oxygen-flask combustion of biological samples for the determination of radiocarbon and tritium. Safety precautions are stressed. The method is not applicable to samples containing volatile radioactivity nor to samples whose net dry weight exceed about 250 mg. (P.C.S.)

25781 MAN-MADE ^{14}C: A POTENTIAL AID TO FORENSIC SCIENCE INVESTIGATIONS. Walton, A. (Univ. of Glasgow). J. Forensic Sci. Soc., 6: 2-6(Jan. 1966).

The introduction of ^{14}C into the biosphere by nuclear weapons tests is discussed in relation to the use of this artificially created isotope in forensic studies. It is suggested, for example, that if ^{14}C atmospheric concentrations are well documented during the coming decade, this isotope could be used to assess the time since death of recent human remains. Causes of the marked increase in ^{14}C concentrations in the environment from 1955 onwards are discussed. Data on ^{14}C concentrations in human samples during the last decade are considered. Application of ^{14}C to short-term dating problems could be extended to studies of all materials in the biosphere. In particular, its potential application to studies of natural fibers, human blood, tissue, and bones are discussed. Ages of such materials might be determined to within a few months in ideal circumstances. (TSS)

25782 MASS SPECTROMETRIC ANALYSIS OF BORON ISOTOPES IN TRIMETHYL BORATE. Opauszky, Istvan; Matus, Lajos; Kiss, Istvan (Central Inst. of Physical Research, Budapest). Magyar Kem. Foly., 72: 346-50(Aug. 1966). (In Hungarian).

The mass spectrum of trimethyl borate was investigated in order to develop a method by which the isotopic ratio $^{11}B/^{10}B$ could be directly determined from the mass spectrum of the compound. Which of the ions that must be compared with respect to intensity to perform the isotopic analysis was determined. The method suggested allows evaluation of isotopic composition without using standards of pure isotopes. (auth)

25783 DIFFERENTIAL SPECTROPHOTOMETRIC ANALYSIS OF TWO-COMPONENT SYSTEMS. Ganopol'skii, V. I.; Barkovskii, V. F.; Alikina, N. A. (Ural State Univ., Sverdlovsk, USSR). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol., 10: 145-50(1967). (In Russian).

A method of differential spectrophotometry was used for analysis of two-component systems with superimposed absorption lines. For Sn–Eu and Sm–Dy systems the method was very effective. (R.V.J.)

25784 AGE ESTIMATION ACCORDING TO THE POTASSIUM-ARGON METHOD WITH THE HELP OF ACTIVATION ANALYSIS. ANALYTICAL ACCURACY. Wagener, K.; Ziessow, D.; Zimen, K. E. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Z. Naturforsch., 21a: 1989-92(Nov. 1966). (In German).

From ten activation analyses of the Ar content in a sample of uniform composition (Sylvinite), the mean statistical error of an individual determination was calculated as ±4.4%. The degassing of the minerals was done by complete sublimation of the samples. The transfer of the rare gases obtained into the gas counter tube was carried out using carrier Ar with a yield of 99.99%. The analysis accuracy obtained corresponds to that of mass spectrometric determination. The simple and rapid procedure of the activation analytical method makes it especially suitable for routine application. (tr-auth)

25785 THE MICRODETERMINATION OF CRYOLITE IN CORDITES BY THE OXYGEN-FLASK TECHNIQUE. Gallacher, E. J.; Wright, H. (Ministry of Aviation, Explosives Research and Development Establishment, Essex, Eng.). Mikrochim. Acta, 3: 535-8(1967).

Cryolites in cordite were determined by measuring the concentration of fluoride ion in the products of combustion of the propellant in oxygen. Interfering elements were removed by ion exchange resin and the fluorine determined either by titration with thorium nitrate or colorimetrically with cerium-alizarin complexone. The method provides a rapid means of isolating inorganic additives from propellant explosives. (auth)

25786 USE OF X-RAY SPECTROMETRY IN ACTIVATION ANALYSIS: DETERMINATION OF BROMINE. Shenberg, Cesia; Gilat, Jacob; Finston, Harmon L. (Soreq Nuclear Research Centre, Yavne, Israel). Anal. Chem., 39: 780-5(June 1967).

X-ray counting of ^{80}Br and ^{80m}Br was applied to the determination of submicrogram amounts of bromine in neutron-irradiated samples containing a large excess of common interfering elements. The precision of the method is about 2%, and an accuracy of 2 to 5% can be attained for Na/Br or K/Br ratios up to 500 : 1. The method also provides a means of fast analysis of milligram amounts of bromine in organic matter. The advantages of x-ray counting and spectrometry over conventional scintillation gamma spectrometry in nondestructive neutron activation analysis are discussed. (auth)

25787 SENSITIVITIES FOR ACTIVATION ANALYSIS OF 15 LIGHT ELEMENTS WITH 18-MeV ^{3}He PARTICLES. Ricci, Enzo; Hahn, R. L. (Oak Ridge National Lab., Tenn.). Anal. Chem., 39: 794-7(June 1967). (ORNL-P-2507).

An experimental survey was made to appraise the possibilities of ^{3}He activation analysis in the determination of elements from beryllium to calcium. Thick targets of these elements were bombarded with 18-MeV ^{3}He particles from the ORNL Tandem Van de Graaff accelerator. A simplification was introduced in the mathematical treatment of charged particle activation analysis that makes it possible to use range data directly read from range-energy tables of curves without any further elaboration. Instrumental sensitivities for gamma spectrometry were obtained for the above elements from duplicate experiments and absolute sensitivities were calculated from the instrumental values. The sensitivities are all high; in particular, those for beryllium, boron, carbon, nitrogen, oxygen, fluorine, and sulfur range from 0.123 to 1.12 cpm/ppB μA. This group of elements cannot be easily determined at the ppB level by other techniques; thus, ^{3}He-activation promises to fill the gap left by other methods. (auth)

25788 ANION EXCHANGE SEPARATION AND SPECTROPHOTOMETRIC DETERMINATION OF TITANIUM IN URANIUM-PLUTONIUM TERNARY ALLOYS. Evans, Harold B.; Hallcock, Rozetta R. (Argonne National Lab., Ill.). Anal. Chem., 39: 842-4(June 1967).

Anion exchange chromatography was used for the determination of Ti in U–Pu alloys. The method depends on the quantitative retention of plutonium and uranium on the resin column while titanium passes through the eluate where it is determined spectrophotometrically as the peroxy complex. The advantages are simplicity, adaptability to glove-box operations, and minimum operator time. The separation was 99.99% effective with a relative standard deviation of 0.3% over the range studied. (J.G.B.)

25789 DETERMINATION OF ^{90}Sr IN HUMAN BONES BY TRIBUTYL PHOSPHATE. Baratta, Edmond J.; Ferri, Esther S. (Dept. of Health, Education, and Welfare, Winchester, Mass.). Anal. Chem., 39: 846-7(June 1967).

Yttrium-90, which is in equilibrium with strontium-90 at time of analysis, was directly extracted from bone ash in approximately 14$\underline{N}$ HNO_3 with 100% $\underline{n}$-tributyl phosphate (TBP), and was stripped from the TBP into 3$\underline{N}$ HNO_3. The Y was then precipitated as the oxalate for counting. The method permits the determination of strontium-89, if this nuclide is present, by conventional purification treatment of the separated strontium fraction. It also permits remilking of Y from the strontium fraction after suitable ingrowth. The procedure requires 2.5 man-hours for analysis of four samples. (J.G.B.)

25790 THEORY OF RADIOMETRIC PRECIPITATIONAL TITRATION OF LABELED SAMPLES WITH AN INACTIVE MEASURING SOLUTION. Jesenak, V.; Veltyni, J.; Toelgyessy, J. (Slovak Technical Univ., Bratislava). Atompraxis, 12: 606-9 (Dec. 1966). (In German).

The relations among various parameters in radiometric precipitational titration of a labeled ion with an inactive standard solution studied at any given stoichiometry of the precipitating reaction were examined. These relations were then converted into non-dimensional equations, evaluated for variables within wide limits, and presented graphically in order to illustrate the influence of the experimental conditions. The exact evaluation of the measurement results according to the derived equation makes it possible to use precipitation reactions in which a precipitate of a relatively high solubility product is formed. A simplification of the equation for solubility products of low values facilitates evaluation of the results measured. For serial analyses, a graphical evaluation method is suggested. (auth)

25791 RAPID DETERMINATION OF ^{32}P. Taylor, R. W.; Boulogne, A. R. (E. I. du Pont de Nemours and Co., Aiken, S. C.). Health Phys., 13: 657-9(June 1967). (DP-MS-66-18).

A method for the determination of ^{32}P in waste water and biological samples is presented. Biological samples were dissolved in HNO_3 then evaporated to dryness and dissolved in H_2SO_4. The sample was extracted into 1-butanol by phosphomolybdic acid and made water soluble by adding ethanol. Calcium chloride and phosphate carrier were added and calcium phosphate precipitated and dissolved in HNO_3. The solution was plancheted and counted. Recovery values for ^{32}P were 85 ± 5% for hair; 84 ± 6% for plant waste water; 66 ± 8% for algae; and 66 ± 8% for fish flesh. (D.H.M.)

25792 BORON DETECTION IN METALS BY ALPHA-PARTICLE TRACKING. Armijo, J. S.; Rosenbaum, H. S. (General Electric Co., Pleasanton, Calif.). J. Appl. Phys., 38: 2064-9(Apr. 1967).

Track-etching techniques were used to detect boron in austenitic steels. The technique involved placing polymers known to be sensitive to alpha particles in intimate contact with the polished metal surface, exposing the specimen to neutrons, and then etching the polymer detector. Alpha tracks that result from the $^{10}B(n,\alpha)^{7}Li$ reaction were developed in the polymer by etching in an aqueous NaOH solution. The boron concentration in the steels was quantitatively determined and results compared with more conventional analytical techniques. It is seen that in addition to measuring the total boron content, the track-etch method allows the distribution of boron within the microstructure of the metallic alloy to be mapped. The detector materials used were cellulose nitrate and cellulose acetate butyrate. The technique is useful for measuring boron concentrations in the ppM range. (auth)

25793 MASS SPECTROMETRY: THE SHAPES OF "METASTABLE PEAKS." Beynon, J. H.; Fontaine, A. E. (Imperial Chemical Industries Ltd., Manchester, Eng.). Z. Naturforsch., 22A: 334-46(Mar. 1967).

The effect on the shape of "metastable peaks" arising from decompositions throughout the whole flight path in a mass spectrometer is considered. The effects of discriminations against product ions are calculated; the effects of finite beam dimensions, angular spreading, and kinetic energy of separation of fragments during the decomposition are discussed theoretically and illustrated by practical examples. (auth)

25794 IONIZATION MECHANISM OF ADMIXTURES OF PERMANENT GASES IN ARGON IN RADIONIZATION DETECTORS APPLIED IN GAS CHROMATOGRAPHY. Lasa, Jan (Inst. for Nuclear Research, Krakow). Nukleonika, 12: 235-44 (1967). (In Polish).

The results of an investigation on the cross-section type radioionization detector are presented. This detector was used in gas chromatography with helium, hydrogen, and argon as the carrier gases. The nonlinear dependence between the detector output current and the concentration of permanent gases were observed when argon as a carrier gas was applied. The function describing this dependence has a maximum for a determined value of concentration C_x. This phenomenon may be involved by the changes of the electron mobility as well as by the production of the complex ions and by interactions between the excited atoms of argon and molecules of impurities. (auth)

25795 RADIOACTIVITY OF RAW MATERIALS FOR THE POLISH PHOSPHORUS INDUSTRY. Matenko, Juliusz. Nukleonika, 12: 177-81(1967). (In Polish).

The specific radioactivity of raw materials imported to Poland from Morocco, Jordan, Tunisia, Egypt, and the U.S.S.R. in the years 1962 to 1965 was determined. The content of natural uranium in the minerals was radiometrically established as equal to 0.03 to 0.80 mg/g of material. In the non-local beta activity no influence of the radioactive calcium group and potassium has been discovered. The experiments allowed uranium migration to be established in the process of superphosphate production and called attention to the possibility of uranium assimilation by plants from superphosphate and of the uranium concentration in the dust-laden air of factory halls exceeding permissible limit. (auth)

25796 DETERMINATION OF TRACE AMOUNTS OF MAGNESIUM, STRONTIUM, AND NICKEL IN LAKE-WATER SAMPLES BY NEUTRON-ACTIVATION ANALYSIS. Souliotis, A. G.; Belkas, E. P., Grimanis, A. P. (Nuclear Research Center Democritos, Athens). Analyst, 92: 300-4(May 1967).

Neutron activation analysis was used to determine magnesium, strontium, and nickel in water from eleven Greek lakes. The elements were separated by an isolation procedure (taking up to 30 minutes); the magnesium and strontium were determined by γ-spectrometry, and the nickel by β-coincidence counting. The ranges found were 11 to 31 ppM of magnesium, 0.02 to 1.12 ppM of nickel, and 0.07 to 0.48 ppM of strontium. (auth)

25797 1-HYDROXY-ETHYLIDENE-1,1-DIPHOSPHONIC ACID AS A TITRIMETRIC AGENT. Pribil, R.; Vesely, V. (Heyrovsky Polarographic Inst., Prague). Talanta, 14: 591-5 (May 1967).

1-Hydroxy-ethylidene-1,1-diphosphonic acid (HEDPHA) was proposed as a highly selective titrimetric reagent for thorium. In the presence of 1,2-diaminocyclohexanetetra-acetic acid (DCTA) a soluble binuclear ternary complex, $Th_2(DCTA)_2$ (HEDPHA), was formed. The determination of thorium was carried out in a slightly acidic medium, buffered with urotropine, with 0.025M HEDPHA, and Xylenol Orange as indicator. DCTA masks all bivalent metals, rare earths, scandium, yttrium, bismuth, iron, gallium, and indium. Only zirconium, titanium, aluminium, and large amounts of thallium(III) interfere. (auth)

25798 ^{85}Sr TRACER METHOD FOR DETERMINATION OF ^{90}Sr. A REVIEW OF 4 YEARS EXPERIENCE. Geiger, Eric L. (Eberline Instrument Corp., Santa Fe, N. Mex.). Health Phys., 13: 607-12(June 1967).

A systematic and statistical review of ^{90}Sr data obtained from 2538 samples analyzed in duplicate over a 4-year period is presented for three types of samples analyzed by a ^{85}Sr internal tracer technique. The procedure provides a high degree of accuracy and selectivity for ^{90}Sr. The routine sensitivity of the method is 0.0 ± 0.7 dpm/sample aliquot at the 95% confidence level. The agreement between duplicate aliquots was excellent for milk and vegetation samples. For soil, some procedure error in excess of counting error was indicated, but the magnitude of this error was generally less than 10%. (auth)

25799 PROGRESS IN NUCLEAR ENERGY. SERIES IX. ANALYTICAL CHEMISTRY. VOLUME 7. Elion, H. A.; Stewart, D. C. (eds.). Progr. Nucl. Energy, Ser. IX, 7: 1-288 (1966).

Topics discussed are: electron diffraction techniques and their applications to the study of surface structure; liquid scintillator solutions in nuclear physics and chemistry; in-line analytical instrumentation of nuclear fuel reprocessing plants, and the ion microprobe mass spectrometer. A table of coefficients for the microprobe analyst, and tables of x-ray data are also presented. (239 references). (J.G.B.)

25800 RADIOCHEMICAL METHODS OF NUCLEAR FUEL BURN-UP. Bezdek, Miroslav; Krtil, Josef (Inst. for Nuclear Research, Czechoslovak Academy of Sciences, Rez). Jad. Energ., 13: 161-9(May 1967). (In Czech).

A brief review is given of various methods for determining the degree of nuclear fuel burnup described in published literature. The influence of various factors on the accuracy of determination is analyzed and some equations are given for computing the burnup. A radiochemical isolation method for preparation of radiochemically pure radioisotopes (^{137}Cs and ^{144}Ce) is described. The advantages of separation methods and selection of suitable radioisotopes are discussed. (tr-auth)

25801 DISTRIBUTION OF SOME TRACE ELEMENTS IN IRON METEORITES, AS DETERMINED BY NEUTRON ACTIVATION. Smales, A. A.; Mapper, D.; Fouche, K. F. (Atomic Energy Research Establishment, Harwell, Eng.). Geochim. Cosmochim. Acta, 31: 673-720(May 1967).

The ten trace elements germanium, arsenic, antimony, copper, chromium, molybdenum, silver, indium, zinc, and palladium were determined in 67 different meteorites, using neutron activation and radiochemical separations. In addition, the meteorites were analyzed for gallium using both neutron activation and colorimetric methods. The sulphur content of 25 of the meteorites was measured, using an evolution and colorimetric method. The meteorites analyzed consisted of a reasonably representative selection of all the structural types of irons. The distribution of the determined trace elements is discussed, in relation to the structural classifications of the iron meteorites. It is shown that a number of meteorites belong to specific structural classes have the same or closely similar trace element composition Particular attention is paid to the behavior of germanium and gallium, following the widely accepted division of iron meteorites into four distant Ga–Ge "quantized" groups. It is also shown that arsenic, antimony, silver, indium, and zinc are generally concentrated in the coarse and coarsest octahedrite groups, compared with the remaining structural groups. In the case of indium this behavior was observed even at the 0.0005 to 0.01 ppM levels. The distribution of zinc did not appear to be related to that of sulphur. The structural groups are discussed in relation to the evolution of iron meteorites, and to possible correlations with cosmic-ray exposure ages. (auth)

25802 ABUNDANCES OF SELENIUM, TELLURIUM, SILVER, PALLADIUM, CADMIUM, AND ZINC IN CHONDRITIC METEORITES. Greenland, L. (Univ. of California, San Diego, La Jolla). Geochim. Cosmochim. Acta, 31: 849-60(May 1967).

The abundances of the elements Se, Te, Ag, Pd, Cd, and Zn were determined in a number of carbonaceous, enstatite, and ordinary chondrites by a neutron activation technique. Of these, only palladium was essentially unfractionated among the various chondrite groups; the fractionation of the other elements is generally consistent with the model proposed by Anders (1964). (auth)

25803 PHOTON-ACTIVATION ANALYSIS OF CESIUM. Persiani, C. (Republic Aviation Corp., Farmingdale, N. Y.); Spira, J.; Bastian, R. Talanta, 14: 565-73(May 1967).

The corrosive behavior of caesium was attributed in part to the presence of a non-metallic impurity such as oxygen. A photon-activation method for determining oxygen and carbon in caesium is described. Scintillation coincidence-counting and pulse-height discrimination are used to count the gamma activity resulting from annihilation of the positrons emitted. Variation of beam energy was investigated in order to obtain optimum irradiation conditions. In the samples analyzed, and under the conditions used, less than 100 ppM of oxygen and carbon could be detected. Results are compared with those from other methods. (auth)

25804 INSTRUMENTAL CHEMICAL ANALYSIS OF THE MOON SURFACE BY UNMANNED LANDING DEVICES. Schmidt, Diether (Univ., Marburg, Ger. Univ. of Kentucky, Lexington). Raumfahrtforschung, 11: No. 1, 27-35(Jan.-Mar. 1967). (In German).

The chemical analysis techniques that can be used in analysis of the lunar surface are outlined and reviewed. These include sampling devices, mass spectrometry, gas chromatography, α scattering, α-proton reactions, inelastic neutron scattering, activation analysis, γ spectrometry, x-ray fluorescence spectrometry, x-ray diffraction, petrographic microscopy, differential thermal analysis, magnetic susceptibility, and isotope age determination. Typical devices and measurement results are shown. (58 references). (J.S.R.)

25805 SMALL-ANGLE X-RAY SCATTERING STUDIES OF BEEF PANCREAS RIBOSOMES. Bohn, Theodore S.; Farnsworth, Richard K.; Dibble, William E. (Brigham Young Univ., Provo, Utah). Biochim. Biophys. Acta, 138: 212-14(Mar. 29, 1967).

The radius of gyration of beef pancreas ribosomes was found to be 91 Å as determined by small-angle x-ray scattering. There was evidence of aggregation, at least to the extent of dimerization. From the data a diameter of 290 Å was calculated which agreed with electron micrograph measurements. Uranyl acetate staining increased the angle of gyration to an extent which could be accounted for by the addition to the particle of one mole of uranyl acetate for each phosphate of RNA. This suggested that the RNA might be distributed throughout the particle rather than only on the surface. (M.M.B.)

25806 HARD, SOFT, AND ULTRASOFT X RADIATIONS COMBINED WITH FAST-NEUTRON ACTIVATION, APPLIED TO THE TOTAL ANALYSIS OF ROCKS. Volborth, A. (Univ. of Nevada, Reno). pp 117-42 of Materials Science and Technology for Advanced Applications. Vol. II. Golden Gate Metals Conf., Feb. 13-15, 1964. Berkeley, Calif., American Society of Metals, 1964.

Lab facilities, instrumentation, and techniques for neutron activation and x-ray spectrographic analysis of rocks are described and illustrated. It is shown how an entirely nondestructive instrumental analysis of rocks, including all major and some trace elements, can be performed using these 2 basic methods. Details are given for nondestructive determination of the major rock constituents: O, Na, Mg, Al, Si, K, Ca, Ti, Mn, and Fe. Oxygen can be determined with high precision and accuracy by fast-neutron activation. The neutron generator used is described. The method permits about 4 rock analyses per day. Precision of neutron activation determination of oxygen varies from 1 to 3% in terms of relative standard deviation, and accuracy is 1 to 10 mg in 1000 mg of oxygen in a 2-g rock sample. It is shown, with MnO as an example, that trace elements can be determined in pressed rock powders with a precision equivalent to 10 ppM in standard deviation. Main advantages of this combination of methods are nondestructiveness, speed, high precision and accuracy, mutual statistical compatibility, and the ability to double check the results by independent oxygen determination. (BBB)

25807 A TRIAL METHOD OF DETERMINING URANIUM AND THORIUM CONTENT OF ROCKS IN RADIOACTIVE DISEQUILIBRIUM BY NEUTRON ACTIVATION ANALYSIS. I. Hatuda, Zin'itiro (Kyoto Univ.); Nishimura, Susumu; Asayama, Tetsuji Mem. Coll. Sci., Univ. Kyoto, Ser. B, 33: 47-51(Nov. 1966).

Procedures are described for determining the U and Th content of some basic lavas by the neutron activation method. The rock samples are first activated by bombardment and then subjected to spectrometry after an optimum period of cooling, during which most of the induced short-lived nuclides have decayed. These lavas revealed radioactive disequilibrium by α and γ spectra interpretation. The U content of some lavas of younger ages was found to be smaller than that calculated from their Ra content assuming radioactive equilibrium, while their Th/U ratios were of average value for such rocks. The Th/U ratio ranged from 2.33 to 3.72 with an average of 3.11, which is a reasonable value for basic lavas. The Ra content of these lavas was excessive because the time elapsed since their eruption was shorter than that required for attaining radioactive equilibrium between U and Ra. (BBB)

25808 RADIOMETRIC TITRATIONS. Braun, T.; Toelgyessy, J. International Series of Monographs in Analytical Chemistry. Volume 29. New York, Pergamon Press, 1967. 177p.

Radiometric titrations based on precipitate formation, complex formation, and redox reactions are presented. (164 references). (J.G.B.)

25809 ANALYSIS OF THE NEW METALS. TITANIUM, ZIRCONIUM, HAFNIUM, NIOBIUM, TANTALUM, TUNGSTEN, AND THEIR ALLOYS. Elwell, W. T.; Wood, D. F. New York, Pergamon Press, 1966. 285p.

Procedures are described for the determination of 29 elements in Ti and its alloys, and 34 elements in Zr and Hf and their alloys. Procedures for the analysis of Nb, Ta, W, and their alloys are also included. (165 references) (J.G.B.)

25810 CHEMICAL ANALYSIS OF RADIOACTIVE MATERIALS. Lavrukhina, A. K.; Malysheva, T. V.; Pavlotskaya, F. I. International Scientific Series. Cleveland, Chemical Rubber Company Press, 1967. 394p. $13.25.

Translated from Rakiokhimicheskii Analiz by Scripta Technica, Ltd.

The contents of the book are divided into 5 sections. The first two sections are devoted to the theoretical aspects of the field covering the state and behavior of radioelements in solution and the theoretical bases of radiochemical analysis. The third section deals with the identification of isotopes. The two concluding sections provide a detailed description of specific procedures including the isolation and concentration of the radioelements and methods of isolating individual elements in the radioactively pure state. (B.L.M.)

25811 IMPROVEMENTS IN OR RELATING TO X-RAY ANALYSIS. Boyce, Ian Stanley; Ahier, Thelma Grace (to United Kingdom Atomic Energy Authority). British Patent 1,067,430. May 3, 1967. Filed Sept. 11, 1964.

A method of x-ray analysis using backscattering geometry for determination of a wanted component in a sample containing an interfering element comprises passing primary x rays into the sample so that secondary x rays are obtained from the sample in a backscattered direction together with fluorescent x rays from the interfering element. The energy of the primary x rays is so selected that such fluorescent x rays are relatively inefficiently excited, and the energy of the secondary x rays is greater than the energy of the fluorescent x rays. The total intensity of the secondary x rays plus the fluorescent x rays is measured using a detector that is adapted to be more sensitive to the lower-energy fluorescent x rays than it is to the higher-energy secondary x rays. (B.L.M.)

Inorganic, Organic, and Physical Chemistry

Refer also to abstracts 25868, 25935, 26028, and 26120.

25812 (AGN-8192(Vol.1)) ALKALI METALS EVALUATION PROGRAM. THERMODYNAMIC AND TRANSPORT PROPERTIES OF CESIUM AND RUBIDIUM PVT PROPERTIES. Achener, P. Y.; Miller, A. R.; Fisher, D.; Olbrantz, M. (Aerojet-General Corp., San Ramon, Calif. Nuclear Products and Services Group). Feb. 1967. Contract AT(04-3)-368. 104p. Dep. CFSTI.

The pressure-volume-temperature properties of superheated cesium vapor were determined at temperatures from 1067.1 to 1489.3°K at pressures from 2.178 to 12.74 atm, and of superheated rubidium vapor at temperatures from 1067.4 to 1493.7°K at pressures from 2.075 to 14.80 atm. The experimental method involved the use of a constant volume capsule fitted with a null-type diaphragm for the measurement of pressure. The experimental data was used to develop virial equations of state explicit in pressure, from which the desired properties of enthalpy, entropy, specific heat, and compressibility were calculated. (auth)

25813 (BMwF-FBK-67-12) EXPERIMENTELLE UNTERSUCHUNG CHEMISCHER REAKTIONEN VON URAN, URANDIOXID UND URANCARBID MIT LUFT UND WASSERDAMPF IM TEMPERATURBEREICH VON 1000 BIS 2200°C. (Experimental Investigation of Chemical Reactions of Uranium, Uranium Dioxide, and Uranium Carbide With Air and Water Vapor in the Temperature Range Between 1000 and 2200°C). Henzel, N.; Kleine-Tebbe, A. (Battelle Institut e. V., Frankfurt am Main (West Germany)). Feb. 1967. 121p. (In German). Dep.

The initial phase of the reactions, isothermally investigated to 2200°C in the framework of a reactor safety program, yields UO_2, UO_{2+y}, or U_3O_8, respectively. The reaction rate is proportional to the partial pressure of the gas, but hardly affected by the absolute pressure. At standard pressure it is a linear function of time for the system U/air, for others a higher (maximum third power) function. At 0.1 atm partial pressure in argon, linear time functions are found, except for $UC/H_2O(g)$ (higher order) and $U/H_2O(g)$ (erratic). Arrhenius plots show activation energies around 10 kcal/U for U/air, $U/H_2O(g)$, and UC/air, in contrast to 50 kcal/mole for $UO_2/H_2O(g)$. No definite value was found for $UC/H_2O(g)$. The UO_2/air curve has a maximum at 1500°C. According to a pessimistic energy balance, based on the reaction enthalpies and simplified estimates of the heat losses, selfsustaining reactions are quite possible for U and UC, not for UO_2, systems, although their probability decreases with increasing temperatures. (auth)

25814 (BMwF-FBK-67-13) EXPERIMENTELLE UNTERSUCHUNG CHEMISCHER REAKTIONEN VON URAN, URANDIOXID UND URANCARBID MIT LUFT UND WASSERDAMPF IM TEMPERATURBEREICH VON 600 BIS 1300°C. **(Experimental Investigation of Chemical Reactions of Uranium, Uranium Dioxide, and Uranium Carbide With Air and Water Vapor in the Temperature Range From 600 to 1300°C). Poeschel, E.; Skoutajan, R. (Battelle Institut e. V., Frankfurt am Main (West Germany)). Feb. 1967. 112p. (In German). Dep.**

The reactions were studied thermogravimetrically at O_2 or H_2O partial pressures of 0.1 to 1 atm, respectively, and a total pressure of 1 atm. For U/air and UC/air, a linear time law was found, for $U/H_2O(g)$ a parabolic law, and for $UO_2/H_2O(g)$ a parabolic or a linear law, depending on the temperature. No reaction was observed for $UO_2/H_2O(g)$ during brief periods; that of $UC/H_2O(g)$ depended on the storage time. The activation energy for U/air amounts to 6.4 kcal/gram-atom, that of UO_2/air to 7.0 and 23.6 kcal/mole in the validity range of the linear and the parabolic time law, respectively, and to 15.6 to 18.9 kcal/gram-atom for $U/H_2O(g)$. The reaction rates for U/air and UC/air are proportional to the pressure; for $U/H_2O(g)$ the effect of pressure was ill-defined. In the validity range of the linear time law for UO_2/air, the reaction rate RG = const. $\cdot p^{0.8}$; in the range of the parabolic time law the reaction rate is pressure-independent. The conversions U/air (incomplete oxidation) and $U/H_2O(g)$ yield UO_2; UO_2/air and UC/air give U_3O_8. The heat fluxes calculated from the conversions range from 10 to 370 cal/cm²min. (auth)

25815 (BNLW-CC-484) RELEASE OF NOBLE GASES FROM AQUEOUS SOLUTION. Postma, A. K. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Jan. 10, 1966. Contract AT(45-1)-1830. 12p. Dep. CFSTI.

The release rate of noble gases from an aqueous solution was studied from a mass transfer standpoint. The factor that controls the release rate is the rate of surface renewal, or equivalently, the liquid film coefficient, k_L. The numerical value of k_L depends on the degree of mixing in the liquid, hence cannot be accurately predicted for most practical situations. Experimental measurements of others are used to arrive at expected limits on the time of release. Experiments are briefly described which would allow a more accurate prediction of release time for a given water basin. (auth)

25816 (EUR-3281.e) THE RADIOLYTIC AND PYROLYTIC DECOMPOSITION OF ORGANIC COOLANTS. V. THE THERMAL DECOMPOSITION OF o-, m-, AND p-TERPHENYL IN THE PRESENCE OF ATTAPULGUS CLAY. Juppe, G.; Rau, H. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Dec. 23, 1966. 38p. Dep.

The kinetics of the pyrolysis of pure o-, m- and p-terphenyl and of material mixed with Attapulgus clay were studied. Ten to twelve times more o-, m- and p-terphenyl was decomposed in the clay-catalyzed experiments and a strong isomerization of o- into m- and p-, and m- into p-terphenyl appeared. Twice as much benzene and diphenyl was formed in the clay-added runs. Similar differences were obtained for the quaterphenyl, triphenyl, and triphenylbenzene formations. From the catalyzed experiments 50 times as much total gas was found consisting of 37% H_2, 19% methane, 7% ethane, 2% propane, 1.5% n-pentane, 3.8% isopentane, 2.5% ethylene, 0.4% acetylene, 0.9% propene, and 2% butenes. The uncatalyzed runs yielded 82% H_2, 4% methane, 1% ethane, 0.4% propane, 0.2% n-pentane, 0.3% isopentane, 10% ethylene, 2.8% acetylene, 1.2% propylene, and 2% butenes. It is suggested that the thermal decomposition of pure terphenyls follows a radical mechanism while the clay-catalyzed pyrolysis follows a carbonium ion mechanism. (auth)

25817 (IS-T-140) THE STRUCTURE AND INFRARED SPECTRA OF THE TETRAHALOBIS(ACETONITRILE)NIOBIUM(IV) COMPLEXES. Dougherty, Thomas Anthony (Ames Lab., Iowa). Feb. 1967. Contract W-7405-eng-82. 83p. Dep. CFSTI.
Thesis.

The structure of tetrabromobis(acetonitrile)niobium(IV) was determined by x ray diffraction techniques. Single crystals were grown from acetonitrile solution. The compound crystallized in the orthorhombic space group $Pna2_1$, with lattice parameters a = 13.92 ± 0.01, b = 6.58 ± 0.01, and c = 13.63 ± 0.01 Å. The complex was a slightly distorted octahedron with the acetonitrile groups bonded to niobium through the nitrogen atoms in cis positions. The trans and cis Nb–Br bond lengths were found to be identical, within experimental error; the average value was 2.48 ± 0.01 Å. Interatomic repulsions between bromine atoms appeared to distort all Br–Nb–Br from the expected 90° to ca. 97° for the cis bromine atoms. The Nb–N bond length was 2.0 Å. No abnormalities were noted for the ligand bond lengths or angles. The infrared spectra (50-2500 cm^{-1}) were measured for $NbX_4(CH_3CN)_2$, $NbX_5(CH_3CN)$ (X = Cl, Br) and the deuterated bromide analogs. The niobium–bromine stretching modes were assigned to the region 250 to 310 cm^{-1} while the niobium chlorine stretching region was 330 to 420 cm^{-1}. The $NbBr_4(CH_3CN)_2$ complex had three CH_3-C-N bending modes at ca. 400 cm^{-1}. The $NbBr_5(CH_3CN)$ complex had two CH_3-C-N bending modes at this position. These bending modes were shifted to lower frequencies by ca. 25 cm^{-1} upon substitution of CD_3CN for CH_3CN in the complexes. (auth)

25818 (K-L-6150) SURFACE STRUCTURE AND ENERGY OF ADSORPTION DETERMINED FROM DIFFRACTION OF HELIUM BEAMS FROM LITHIUM FLUORIDE. Crews, J. C. (Oak Ridge Gaseous Diffusion Plant, Tenn.). [1964]. Contract W-7405-eng-26. 28p. Dep.

The scattering of helium from lithium fluoride was studied with emphasis on the direction of the diffracted beam, intensity of the specularly scattered beam, intensity of the diffracted beams, and selective adsorption. There were significant deviations of experiment from model predictions based on the like-ion array for (0,-1) diffraction curves at lower grazing angles, and for higher incident angles there was evidence for the existence of two diffraction maxima. The deviation observed at low incident angles was interpreted by a double grating model as being due to unresolved overlap of scattered beams from the two gratings. The diffraction intensity increased with incident angle at low incident angles, went through a maximum in the region of 30°, then began to decrease. The specular intensity was obtained as a function of azimuth angle for an incident angle of 18.5°. At low angles the intensity increased with increasing azimuth angle; between 20 and 30° there was a large reduction in intensity followed by a large increase within a narrow angle range; and above 35° the intensity reached a maximum, which remained approximately constant over the remainder of the region. It was calculated that the range of the energy of adsorption is at least 49 cal/mole. The fraction selectively adsorbed computed from the energy bounds and from the intensity data were 0.2 and 0.37, respectively. (M.C.G.)

25819 (LA-3669) TABLES OF PARA-HYDROGEN DATA IN ENGINEERING UNITS FROM 36° TO 5000°R AT PRESSURES TO 5000 PSIA. Farmer, Otis A. (Los Alamos Scientific Lab., N. Mex.). Feb. 14, 1967. Contract W-7405-eng-36. 159p. Dep. CFSTI.

Tables of thermodynamic-transport and related properties of para-hydrogen are provided in engineering units for the temperature range 36 to 5000°R and the pressure range 13 to 5000 psia. (auth)

25820 (PRNC-94) NEUTRON DIFFRACTION PROGRAM. **Progress Summary Report No. 5. Kay, M. I.; Kaplan, S. F.; Kleinberg, R.; Ritter, H. L.; Almodovar, I.; Cromer, D. T. (Puerto Rico Nuclear Center, Mayaguez). Apr. 1967. Contract AT(40-1)-1833. 47p. Dep.**

Developments in the use of neutron diffraction for studies on chemical binding of atoms in crystals and molecules and the nature of ferromagnetism are reported. The compounds studied include manganese formate dihydrate, copper formate dihydrate, anhydrous copper formate, alums, and nickel and cobalt chloride hexahydrates. Ferroelectric and liquid structures are also discussed. (P.C.H.)

25821 (SC-CR-67-2572) REPORT ON MEASUREMENT OF THE ANGULAR CORRELATION OF POSITRON ANNIHILATION RADIATION FROM CERIUM HYDRIDE. Gustafson, D. R. (Wayne State Univ., Detroit, Mich. Dept. of Physics). [1966]. Contracts AT(29-1)-789; 16-4807. 19p. Dep. CFSTI.
For Sandia Corp., Albuquerque, N. Mex.

The angular correlation of positron annihilation radiation from cerium hydride as a function of H/Ce was examined. The angular correlations for H/Ce = 2.0, 2.3, 2.4, 2.5, 2.6 were found to be nearly independent of H/Ce over this range and similar to the angular correlation from lithium hydride measured by others. The results are consistent with the model of the electronic structure of cerium hydride where hydrogen atoms are assumed to be present as anions. However, certain ambiguities in the data caused by problems with background and sample alignment could not be eliminated and the protonic model cannot be ruled out. (auth)

25822 (TID-22366) THE THERMODYNAMIC PROPERTIES OF IONS IN AQUEOUS AND NON-AQUEOUS SOLUTIONS AT VARIOUS TEMPERATURES. Final Report. Criss, Cecil M. (Vermont Univ., Burlington. Dept. of Chemistry). Oct. 1965. Contract AT(30-1)-3019. 55p. (NYO-3019-3). Dep. CFSTI.

Heats of solution have been measured for several alkali metal, magnesium, and gadolinium halides in the anhydrous solvents, N-methylformamide and N,N-dimethylformamide at 25°C. Whenever possible, these data were extrapolated to infinite dilution both by the simple and an extended Debye-Hückel equation to obtain the standard heats of solution. Standard potentials have been determined for cells of the type, M/MX(NMF)/AgCl; Ag, where M is Li, Na, K, or Cs and X is either Cl^- or Br^-. These potentials have been used in evaluating activity coefficients and obtaining standard free energies of formation for LiCl, NaCl, KCl, CsCl, and NaBr in anhydrous N-methylformamide. Solubility measurements on numerous alkali metal, magnesium, and gadolinium halides have been used to obtain free energies of solution of the corresponding salts in N,N-dimethylformamide. These heat and free energy data, and corresponding data for formamide solutions taken from the literature have been used to calculate the partial molal entropies for numerous simple electrolytes in these three solvents. These have been used in correspondence plots and to elucidate the structure of these solutions. Unexpected heats of dilution for some electrolytes have been observed in these solvents. (auth)

25823 (UCRL–13296) STUDIES ON ELECTRICALLY EXPLODED WIRES. **Final Report Under Lawrence Radiation Laboratory Memorandum Request Number 7007500. Nash, Charles P. (California Univ., Davis. Dept. of Chemistry). May 1967. Contract W-7405-eng-48. 7p. Dep. CFSTI.**

Developments in spectroscopic studies on exploding wires and infrared spectra of adsorbed species are reported. Spectra of the exploding wires were obtained with both space and time resolution. Space resolution was achieved, using the stigmatic character of the spectrograph, by turning the wire so that its axis is at right angles to the spectrograph slit. The method for obtaining the infrared spectra of unsaturated hydrocarbons adsorbed on metal spheres, which are the recondensation products of a wire exploded at 1 atm ambient pressure of argon, is described. (P.C.H.)

25824 (UCRL–17337) SOME CHEMICAL PROPERTIES OF ELEMENT 97. Peterson, Joseph R.; Cunningham, Burris B. (California Univ., Berkeley. Lawrence Radiation Lab.). Jan. 16, 1967. Contract W-7405-eng-48. 5p. (CONF-670602–4). Dep. CFSTI.

From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif.

An investigation of the chemical properties of berkelium is reported that includes solution absorption studies of the tripositive berkelium ion and the preparation and crystallographic characterization of the berkelium oxides, trichloride, oxychloride, and fluorides. Comparison of the lattice parameters of the berkelium compounds and other similar actinide compounds consistently show evidence of the so-called "actinide contraction." (D.H.M.)

25825 (UCRL–70245) THERMAL DECOMPOSITION OF THORIUM DICARBIDE. Weed, H. C.; Morrow, R. J. (California Univ., Livermore. Lawrence Radiation Lab.). Apr. 17, 1967. Contract W-7405-eng-48. 26p. (CONF-670417–1). Dep. CFSTI.

From 69th Annual Meeting of the American Ceramic Society, New York.

The enthalpy of formation of $ThC_2(s)$ at 298.15°K was calculated using experimental data from various sources. The enthalpies of formation were all between -11 and -28 kcal per mole. Their variation with temperature is shown. The $\Delta H°$ at 298°K was estimated as -25 ± 4 kcal for $ThC_2(s)$. (auth)

25826 MASS SPECTROMETRIC ANALYSIS OF RHENIUM AND TECHNETIUM HALIDES. **Rinke, K.; Klein, M.; Schaefer, H. (Univ., Muenster, Ger.). J. Less-Common Metals, 12: 497-503(June 1967). (In German).**

Mixed phases of rhenium trichloride–technetium trichloride, rhenium trichloride–rhenium tribromide as well as the pentachloride, oxychlorides and oxides of rhenium were heated in a mass spectrometer. As primarily vaporized particles all the mixed molecules of $(Re,Tc)_3Cl_9$ and $Re_3(Cl,Br)_9$ were observed. Appearance of Tc_3Cl_{12} was also remarkable. Molecules with Re–Re-bonds containing oxygen were not observed. (auth)

25827 MASS SPECTROMETRIC STUDIES AT HIGH TEMPERATURES. XIX. SUBLIMATION PRESSURES AND HEATS OF SUBLIMATION OF TmF_3, YbF_3, AND LuF_3. **Zmbov, K. F.; Margrave, J. L. (Rice Univ., Houston, Tex.). J. Less-Common Metals, 12: 494-6(June 1967). (ORO–2907-15).**

Mass-spectrometric studies of the high-temperature properties of the rare earth fluorides are reported. The mass spectra of TmF_3, YbF_3, and LuF_3 were found to be nearly identical and quite similar to previous results reported for ScF_3, YF_3, LaF_3, NdF_3, DyF_3, HoF_3, and ErF_3. The temperature dependences of the intense MF_2^+ ions were followed in the range from 1000 to 1150°C. The heats of sublimation and the vapor pressures were calculated. (D.H.M.)

25828 NUCLEAR MAGNETIC RESONANCE SPECTRA OF SOME POLYNUCLEAR THIAPYRYLIUM CATIONS. **Young, Thomas E.; Ohnmacht, Cyrus J. (Lehigh Univ., Bethlehem, Pa.). J. Org. Chem., 32: 1558-62(May 1967).**

Analysis of the NMR spectra of 11 polynuclear thiapyrylium perchlorates in deuteriotrifluoroacetic acid showed that the most strongly deshielded protons (δ 10.69 and 9.42) are associated with the positions of lowest electron density (q_r = 0.722 to 0.869) α and γ to the thionium center of the thiapyrylium rings. Protons β to the sulfur, unless additionally deshielded by angular benzo rings, yield resonance bands on the low-field edge of the normal aromatic region. Despite their strong deshielding (δ_2 10.50 and δ_4 9.70), the 2 and 4 protons of 1-thianaphthalenium ion undergo no apparent deuterium exchange in $CF_3COOD-D_2O$ at room temperature. 2-Thia- and 3-thiaphenanthrenium perchlorates, each of which possesses two different hydrogens α to the sulfur atom, exhibit pronounced α,α' coupling ($J_{\alpha,\alpha'}$ = 3.0 to 3.4 cps) suggesting significant through conjugation via the thionium sulfur. Syntheses of 2- and 4-methyl-1-thianaphthalenium and of 6,7,8,9-tetrahydrobenzo[g]-1-thianaphthalenium perchlorates, required as model compounds for spectral assignments, are also described. (auth)

25829 FREE-RADICAL CHLORINATION REACTIONS OF IODOBENZENE DICHLORIDE. **Tanner, Dennis D.; Van Bostelen, P. B. (Univ. of Alberta, Can.). J. Org. Chem., 32: 1517-21 (May 1967).**

The photoinitiated chlorination of several substituted alkanes with iodobenzene dichloride (IBD) showed product isomer distributions remarkably similar to those obtained for halogenation with molecular chlorine. IBD was previously shown to halogenate 2,3-dimethylbutyl by a mechanism that did not involve chlorine radicals. A more detailed investigation of the mechanism of IBD chlorination, by studying its selectivity, relative reactivity, and primary deuterium isotope effect, confirmed the proposal that the $Ph\dot{I}Cl$ radical was the abstracting species in the radical halogenation reactions of substituted and unsubstituted hydrocarbons. The anomalous results for the halogenation of negatively substituted alkanes are attributed to polar effects on the radical-abstraction reaction. (auth)

25830 STUDIES ON THE REDUCTION OF THORIA BY CALCIUM. Takeuchi, Sakae; Honma, Toshio (Tohoku Univ., Sendai). Nippon Kinzoku Gakkaishi, 31: 42-8(Jan. 1967). (In Japanese).

Various experiments for the reduction of thoria by Ca were performed to determine the most industrially favorable condition for preparing Th metal. The results obtained are summarized. Stainless steel with no surface lining is the most suitable material for a reactor vessel, while the yield deteriorates in the case of a graphite reactor vessel. The optimum particle size of thoria is about 150 µ. A high yield of metal can be obtained by using $CaCl_2$ flux of 20 to 40% for thoria's weight and about 25% in excess of the theoretical amount of Ca. The efficiency of reduction becomes the highest by heating for 4 hr at 950°C or for 3 hr at 1050°C. Under these conditions, about 90% yield of Th metal and 3 to 7% of residue undissolved with HCl can be obtained. (NSA of Japan)

25831 CHEMICAL THERMODYNAMIC PROPERTIES OF PLUTONIUM COMPOUNDS. **Oetting, Franklin L. (Dow Chemical Co., Golden, Colo.). Chem. Rev., 67: 261-97(June 1967).**

A review of the chemical thermodynamics of plutonium compounds is presented that includes tabulation and evaluation of pub lished data. The thermodynamic properties of crystal, liquid, and gaseous plutonium, plutonium hydrides and deuteride, plutonium oxides, plutonium halides and oxyhalides, plutonium carbides, plutonium nitride, and plutonium sulfides and sulfate are given. (D.H.M.)

25832 STUDIES OF PHONON SPECTRA OF CeH_2, CeH_3, ThH_2, AND $UH_{2.7}$ BY MEANS OF INELASTIC SCATTERING OF COLD NEUTRONS. **Karimov, I.; Zemlyanov, M. G.; Kost, M. E.; Somenkov, V. A.; Chernoplekov, N. A. (Inst. of Nuclear Physics, Tashkent). Dokl. Akad. Nauk Uz. SSR, No. 1, 28-9(1967). (In Russian).**

The phonon spectra of CeH_2, CeH_3, ThH_2, and $UH_{2.7}$ were studied by means of inelastic scattering of cold neutrons. The spectra of inelastically scattered neutrons in the hydrides were measured over an energy range from 0.005 to 0.250 eV at ~20°C. (R.V.J.)

25833 DIFFUSE-REFLECTANCE SPECTRA OF RARE-EARTH OXIDES. **White, William B. (Pennsylvania State Univ., University Park). Appl. Spectros., 21: 167-71(May-June 1967).**

Diffuse-reflectance spectra are reported for 11 rare earth oxides of various structural types over the spectral range of 225 to 2700 mµ. These spectra, particularly in the near infrared, permit the use of diffuse-reflectance spectroscopy to identify rare earth ions in solid materials. (auth)

25834 REACTIONS OF AMORPHOUS URANIUM TRIOXIDE WITH METHANE. Vlasov, V. G.; Semavin, Yu. N. Zh. Prikl. Khim., 40: 393-9(Feb. 1967). (In Russian).

The kinetics and the mechanism of the reduction of uranium trioxide by methane at 400 to 500°C and at a pressure of 10 to 600 mm Hg were studied. The rate of the reduction process as a function of methane pressure at constant temperature was found to be $v = k \cdot p_{CH_4}^{0.7 \pm 0.02}$. It was postulated that the surface reaction between the adsorbed product of the methane decomposition (H_2 and CO) and the oxygen of the oxide is the limiting factor in the reduction process. (R.V.J.)

25835 A STUDY OF PHOTOCHEMISTRY OF FLAVINS IN PYRIDINE AND WITH A DONOR. Kurtin, William E.; Latino, Michael A.; Song, Pill-Soon (Texas Technological Coll., Lubbock). Photochem. Photobiol., 6: 247-59(Apr. 1967).

The uv-induced photolysis, under both anaerobic and aerobic conditions, of riboflavin in pyridine yielded several photoproducts, analogous to the photochemical reaction in aqueous solution. Lumiflavin was also photoreduced in pyridine (an electron donor) without decomposition of the isoalloxazine ring. Differences in the reactivity of excited singlet and triplet states with respect to formation of photoproducts were confirmed in pyridine. In the photoreduction of riboflavin by N,N′-dimethyl-N-benzylethylenediamine, an initial rate with a higher relative quantum yield than that of the reaction at a later stage was observed both in water and pyridine. Photolysis in D_2O with the donor showed no significant solvent isotope effect. These results suggest that the photolysis of riboflavin in water does not involve the water molecule in the primary photochemical act. A detailed mechanism of flavin photoreaction in water to account for solvent oxygen incorporation into a photoproduct (benzaldehyde) from N,N′-dimethyl-N-benzylethylenediamine was proposed without involving photochemical splitting of water based on the results and molecular orbital computations. Preliminary results on the kinetics of free radical decay were obtained using an ESR spectrometer and the significance of the results are discussed. (BBB)

25836 STUDIES ON TACTICITY OF POLYACRYLONITRILE. I. HIGH-RESOLUTION NUCLEAR MAGNETIC RESONANCE SPECTRA OF POLYACRYLONITRILE. Yamadera, Reizo; Murano, Masao (Textile Research Inst., Shiga, Japan). J. Polym. Sci., Pt. A-1, 5: 1059-71(May 1967).

The NMR spectra of polyacrylonitriles prepared under various polymerization conditions were measured in NaCNS–D_2O solution. The methylenic proton resonance was separated into two triplets: one is due to the protons of the syndiotactic methylene groups and the other is due to the isotactic ones. The tacticity of polyacrylonitrile was determined by the ratio of integrated intensities of the two triplets. Polyacrylonitriles prepared with radical catalysts were approximately 75% syndiotactic, and polyacrylonitriles prepared by the anionic polymerization at low temperature, γ irradiation in the solid state, Mg molecular beam, and γ irradiation on the urea canal complex were more isotactic but have no remarkable stereoregularity. (auth)

25837 REACTION OF IODINATION OF CADMIUM AND THE ISOTOPIC EXCHANGE IN THE SYSTEM $CdI_2(s)$–$I_2(g)$. Sugier, Henryk (Polytechnic Lodz, Poland). Nukleonika, 12: 367-72 (1967). (In Polish).

The kinetics of cadmium iodination and of the isotopic exchange between solid cadmium iodide and gaseous iodine were investigated. In both cases it was found that: the rate is independent of iodine vapor pressure, the rate is independent of the temperature, and both processes can proceed with one of two rates the ratio of which is as 2 : 1. It was concluded that in the iodination reaction as well as in the isotopic exchange of iodine the rate determining step is the same process occurring at the interface between cadmium iodide and iodine vapor. (auth)

25838 ISOTOPIC EXCHANGE IN THE SYSTEM $PbI_2(s)$–$I_2(g)$ AND THE MECHANISM OF IODINATION OF LEAD. Sugier, Henryk (Politechnic Lodz, Poland). Nukleonika, 12: 357-65 (1967). (In Polish).

The kinetics of isotopic exchange between gaseous iodine and solid lead iodide were investigated. It was found that the activation energy for the isotopic exchange of polycrystalline samples of lead iodide amounts to 9.3 kcal/mol and is the same as for the reaction between lead and iodine while in the case of the exchange of monocrystals it equals zero. It was concluded that in lead iodination as well as in the exchange of iodine with polycrystalline samples of lead iodide the rate-determining step is the diffusion of iodine along the grain boundaries and through the pores. (auth)

25839 MASS SPECTROMETRIC STUDIES OF ION-MOLECULE REACTIONS IN BINARY SYSTEMS. I. DEUTERON TRANSFER REACTIONS BETWEEN D_2O^+ AND SOME UNSATURATED HYDROCARBONS. Wincel, Henryk (Inst. of Nuclear Research, Warsaw). Nukleonika, 12: 183-92(1967).

Deuteron transfer reactions, $D_2O^+ + M \rightarrow MD^+ + OD$, have been observed in D_2O–M systems, where M = ethylene, propylene, butenes, 1-pentene, and 1,3-butadiene. The rate constants and cross sections of the individual reactions were determined and compared to the theoretical predictions. Some data on the mechanism of D^+ transfer reactions in the systems under study are presented. (auth)

25840 KINETIC STUDIES OF HYDROGEN EXCHANGE IN SUBSTITUTED DIALKYLANILINES. PART IV. ISOTOPE EFFECTS AND REACTION MECHANISM. Ling, A. Campbell; Kendall, F. H. (John Cass Coll., London). J. Chem. Soc. (B), No. 5, 445-9(1967).

Isotope effects in hydrogen exchange of dimethylaniline in acid solution were investigated by measurement of exchange rates for tritiation, detritiation, deuteriation, and dedeuteriation in H_2O and D_2O. The results indicate that two distinct rate-limiting steps operate in the electrophilic substitution mechanism. The first is the transfer of a proton from solvent to substrate, the other is an intramolecular decomposition of a carbon conjugate acid ion intermediate. A correlation is observed between magnitude of isotope effect and specific rate constant. (auth)

25841 CATALYSIS OF α-HYDROGEN EXCHANGE. IV. DEUTERIUM EXCHANGE OF METHOXYACETONE. Hine, Jack; Hampton, K. Gerald; Menon, B. C. (Ohio State Univ., Columbus). J. Amer. Chem. Soc., 89: 2664-8(May 24, 1967).

The kinetics of loss of deuterium from methoxyacetone containing deuterium α to the carbonyl group were studied in aqueous solution. Catalytic constants were determined for hydrogen ions, hydroxide ions, water, phenoxide ions, p-nitrophenoxide ions, trimethylamine, triethylamine, N-methylpyrrolidine, and N-methylmorpholine. In the presence of N-methylmorpholine buffers the reaction was slightly subject to catalysis by methylammonium chloride, presumably because of the intermediate formation of an enamine. Exchange at the methyl position was faster (by up to sixfold) than at the methylene position for all the catalysts studied except hydroxide ions, which brought about slightly more rapid exchange at the methylene position. (auth)

25842 VIBRATION ROTATION BANDS OF $^{15}N^{18}O$. Griggs, James L. Jr.; Rao, K. Narahari (Ohio State Univ., Columbus). Contract W-7405-eng-36. J. Mol. Spectros., 22: 383-401(Apr. 1967). (LA-DC-7866; COO-882-9).

A sample of the isotopic nitric oxide molecule $^{15}N^{18}O$ was prepared, and the absorption spectrum studied in the infrared under high resolution. Wavelength measurements and analyses of the 1–0 band at 5.58 μ and the 2–0 band at 2.81 μ yield the following molecular constants (in cm^{-1}): $B_e = 1.5560_3$, $\alpha_e^B = 0.0153_2$, $D_e = 4._7 \times 10^{-6}$; $A_0 = 125.6_6$, $A_1 = 125.2_3$, $A_2 = 125.1_0$; and $\omega_e = 1818.94_1$, $\omega_e x_e = 12.81_7$. The linear dependence of the spin-orbit coupling constant A on the vibrational quantum number v was similar to the results for other isotopic species of the nitric oxide molecule. An overlapping impurity band at 5.43 μ was identified as the 1–0 band of $^{15}N^{16}O$. The theoretical vibrational and rotational isotopic relations were verified to within observational accuracy. (auth)

25843 MICROWAVE SPECTRUM, STRUCTURE, DIPOLE MOMENT, AND BARRIER TO INTERNAL ROTATION OF METHYLTHIOETHYNE. den Engelsen, D. (State Univ. of Utrecht). J. Mol. Spectros., 22: 426-34(Apr. 1967).

The microwave absorption spectrum is reported as well as rotational constants, dipole moment components, and centrifugal distortion constants of methylthioethyne. The spectra of two isotopic species of methylthioethyne were measured, namely, $HC \equiv C-{}^{32}SCH_3$ and $HC \equiv C-{}^{34}SCH_3$; determination of the molecular structure therefore implies some assumptions about certain bond lengths and bond angles. The potential barrier to the internal rotation of the methyl group is derived from the observed doublet splittings. (auth)

25844 CONCURRENT ION-MOLECULE REACTIONS. III. REACTIONS IN MIXTURES OF HCl AND HCN WITH D_2 AND CD_4. Harrison, A. G.; Thynne, J. C. J. (Univ. of Toronto). Can. J. Chem., 45: 1321-7(June 15, 1967).

Concurrent ion–molecule reactions in mixtures of HCl and HCN with D_2 and CD_4 were studied by the ratio plot method. The following reactions were detected in mixtures with HCN and their cross sections determined at 10.5 V cm^{-1} repeller field strength. $HCN^+ + D_2 \rightarrow HCND^+ + D$, $D_2^+ + HCN \rightarrow HCND^+ + D$, $HCN^+ + CD_4 \rightarrow HCND^+ + CD_3$, and $HCN^+ + CD_4 \rightarrow CD_4H^+ + CN$. In mixtures of D_2 and CD_4 with HCl the following reactions were detected and cross sections determined. $D_2^+ + HCl \rightarrow D_2H^+ + Cl$, $D_2^+ + HCl \rightarrow HClD^+ + D$, $HCl^+ + D_2 \rightarrow HClD^+ + D$, $HCl^+ + CD_4 \rightarrow CD_4H^+ + Cl$, and $HCl^+ + CD_4 \rightarrow HClD^+ + CD_3$. Rate constants for the self-reactions in HCN and

HCl were measured both at 10.5 V cm^{-1} repeller field and at thermal ion energies. (auth)

25845 APPLICATIONS OF THERMAL ANALYSIS METHODS TO THE FORMATION OF VANADYL, URANYL, URANIUM(IV), AND TITANYL SULFATES AND THEIR DERIVATIVES IN VARIOUS CONTROLLED ATMOSPHERES. Tridot, Gabriel (Faculte des Sciences, Lille). Pure Appl. Chem., 13: 543-68 (1966). (In French).

The reactions of hydrogen sulfide with titanium, uranium(IV), uranyl, and vanadium sulfates and the effects of hydrogen sulfide on their anhydrous salts and their decomposition products are reported. The degrees of dehydration of hydrated UO_2SO_4 and $U(SO_4)_2$ were determined. Uranyl sulfate is a salt possessing two series of independent hydrates. The formation of vanadyl sulfate under controlled vacuum was shown. The kinetics of the decomposition of $U(SO_4)_2$ were determined. The thermal decomposition curves of UO_2SO_4 showed the existence of a second form of the sulfate, with a different x-ray spectrum from that of the original sulfate. The decomposition of the sulfates of titanyl, uranium(IV), uranyl, and vanadium by hydrogen sulfide was studied and the formation curves are given. The formation of the sulfides VS_4, V_2S_3, V_4S_5, and VS in oxygen atmosphere was determined. The reducing capacity of H_2S at low temperature for uranium oxides and $CaUO_4$ was compared. (J.S.R.)

25846 CARBAMIDE-CONTAINING URANIUM(IV) HALIDES. Golovnya, V. A.; Bolotova, G. T. Zh. Neorg. Khim., 11: 2643-51 (Nov. 1966). (In Russian).

Carbamide-containing halogenides of tetravalent U of the type $UX_4 \cdot \underline{n}CO(NH_2)_2 \cdot \underline{m}H_2O$, where X = Cl, $\underline{n}$ = 3, 4, 7; $\underline{m}$ = 1, 3, 3; X = Br, $\underline{n}$ = 2, 3, 6, 8; $\underline{m}$ = 9, 8, 2, 0; X = I, $\underline{n}$ = 8, 5 and the mixed compounds $UClI_3 \cdot 5CO(NH_2)_2 \cdot 2H_2O$; $UCl_3I \cdot 8CO(NH_2)_2$, $UBr_3I \cdot 6CO(NH_2)_2 \cdot 3H_2O$ were synthesized. It was shown that the optimum number of precombining molecules of carbamide for chloride is four, for bromide is six, and for iodide is eight; that is; the smaller the affinity of the U to the halogenide then the larger the number of precombining neutral ligands. As a result of the synthesis of the octacarbamide compounds the possibility of the existence of cation complexes of tetravalent U of the type $[U(CON_2H_4)_8]X_4$ was shown. The temperature for the initiation of the decomposition of the carbamide-containing halogenides did not depend on the character of the anion and was determined by the beginning of the decomposition of the carbamide. (tr-auth)

25847 LUMINESCENCE OF HEXAVALENT URANIUM IN CaF_2 AND SrF_2 POWDERS. Nicholas, J. V. (Univ. of Canterbury, Christchurch, New Zealand). Phys. Rev., 155: 151-6 (Mar. 10, 1967).

A general investigation into the green luminescence of hexavalent uranium in calcium fluoride was made in the temperature range from 5 to 300°K. Two types of spectra were found due to different centers. Absorption spectra for these were also observed. The luminescent spectrum was interpreted as a no-phonon line with vibrational structure on the sides. Assignment of the lines and bands observed was made on the basis of lattice vibrations, internal local modes of the center, and combinations of these. It was possible to fit the temperature dependence of the width and the position of the no-phonon line with a theoretical curve using the Debye temperature of the lattice determined from the specific heat. The spectrum of hexavalent uranium in strontium fluoride has many similarities, although it shows evidence of other electronic transitions in the luminescent spectrum. (auth)

25848 PREPARATION AND INFRARED SPECTRA OF THE COMPOUNDS $(CH_3)_3GeC-CH$, $(CH_3)_3GeC-CD$, AND $(CH_3)_3SnC-CH$, AS WELL AS $(CH_3)_3SiC-CCH_3$, $(CH_3)_3GeC-CCH_3$, AND $(CH_3)_3SnC-CCH_3$. Steingross, Wolfgang; Zeil, Werner (Univ., Kiel). J. Organometal. Chem., 6: 464-73(1966). (In German).

Trimethylgermylacetylene and trimethylgermylacetylene-d_1 were prepared from trimethylgermylchloroacetylene and phenyllithium, followed by hydrolysis; the d_1 compound was prepared by treatment of the former with ethylmagnesium bromide and hydrolysis in D_2O. The following correlations of ir wavelengths of absorption were suggested for the H and D compounds respectively: ν_1, 2983, 2982; ν_2, 2916, 2915; ν_3, 1408, 1401; ν_4, 1241, 1241; ν_5, 833, 833; ν_6, 581, 583; ν_7, ~220, ~220; ν_8, 497, 486; ν_9, 2030, 1898; ν_{10}, 3290, 2569; ν_{15}, 2983, 2982; ν_{16}, 2983, 2982; ν_{17}, 2916, 2915; ν_{18}, 1408, 1410; ν_{19}, 1408, 1410; ν_{20}, 1241, 1241; ν_{21}, 833, 833; ν_{22}, 769, 769; ν_{23}, 616, 619; ν_{24}, ~220, ~220; ν_{25}, not observed in either case; ν_{26}, not observed in either case; ν_{27}, 316, 305; ν_{28}, 662, 535. Syntheses and ir assignments for the other title compounds were also made. (BBB)

25849 ABSORPTION SPECTRUM OF U^{4+} IN ZIRCON ($ZrSiO_4$). Richman, I. (Aerospace Corp., El Segundo, Calif.); Kisliuk, P.; Wong, E. Y. Phys. Rev., 155: 262-7(Mar. 10, 1967).

The electronic-energy levels of U^{4+} in $ZrSiO_4$ were obtained from the absorption spectra of oriented single crystals. This host was chosen because of the relatively high (D_{2d}) symmetry of the Zr^{4+} site occupied by the U^{4+} ion. Spectra were obtained at a number of temperatures between 4 and 300°K. By means of polarization selection rules, electronic energy levels were identified according to their irreducible representations; then the Slater integrals F_k, the spin-orbit parameter ζ_{5f}, and the crystal-field parameters were determined by a least-squares fit. Because of the large crystal field, it was necessary to diagonalize all these interactions within the $5f^2$ configuration. In all, 30 levels up to 24,000 cm^{-1} were fitted to an average deviation of 110 cm^{-1} by adjusting nine parameters. The results in cm^{-1} are: $F_2 = 185.3$, $F_4 = 37.1$, $F_6 = 3.67$, $\zeta_{5f} = 1780$, $A_2^0\langle r^2\rangle = -349$, $A_4^0\langle r^4\rangle = 400$, $A_4^4\langle r^4\rangle = 770$, $A_6^0\langle r_6\rangle = -435$, and $A_6^4\langle r_6\rangle = 5.7$. The first four "free-ion" parameters are in good agreement with those determined for $UCl_6^=$ complexes. The ratios of the crystal-field parameters showed large deviations from those calculated on a point-charge model, presumably because of the contribution of the polarization of the ligands. (auth)

25850 THERMOCHEMICAL STUDIES ON THE HYDROLYSIS OF THE URANYL ION. Schlyter, Kurt (Royal Inst. of Tech., Stockholm). Trans. Roy. Inst. Technol., Stockholm, No. 195, 32p(1962).

The heats of formation (ΔH) of the hydrolysis products, $(UO_2)_2(OH)_2^{2+}$, $(UO_2)_3(OH)_4^{2+}$, $(UO_2)_3(OH)_5^+$, and $(UO_2)_4(OH)_6^{2+}$ were measured in 3.000 $\underline{M}$ $NaClO_4$ at 25°C. For the reactions: (a) $2UO_2^{2+} + 2H_2O \rightleftharpoons (UO_2)_2(OH)_2^{2+} + 2H^+$, (b) $3UO_2^{2+} + 4H_2O \rightleftharpoons (UO_2)_3 \times (OH)_4^{2+} + 4H^+$, (c) $3UO_2^{2+} + 5H_2O \rightleftharpoons (UO_2)_3(OH)_5^+ + 5H^+$, and (d) $4UO_2^{2+} + 6H_2O \rightleftharpoons (UO_2)_4(OH)_6^{2+} + 6H^+$, at 25°C the following equilibrium constants were determined: $-{}^{10}\log k$ = (a) 6.030 ± 0.005, (b) 13.200 ± 0.050, (c) 16.550 ± 0.008, and (d) 19.420 ± 0.060, and the following reaction heats (in kcal per mole): ΔH^0 = (a) 9.442 ± 0.109, (b) 18 ± 5, (c) 25 ± 2, (d) 24 ± 5. The molar entropy changes (in cal $degree^{-1}$ $mole^{-1}$) were: ΔS^0 = (a) 4.09 ± 0.37, (b) 0 ± 17, (c) 8 ± 7, (d) −8 ± 17. The high uncertainties of the ΔH^0 and ΔS^0 values for the reactions (b), (c), and (d) were explained by the fact that the corresponding species, $(UO_2)_3(OH)_4^{2+}$, $(UO_2)_3(OH)_5^+$, and $(UO_2)_4(OH)_6^{2+}$, represent only a small fraction of the hydrolysis products. (BBB)

25851 INFRARED ABSORPTION SPECTRA OF THORIUM DISULFITE AND ITS THERMAL DECOMPOSITION PRODUCTS. Kharitonov, Yu. Ya.; Tverdokhlebov, V. N.; Molodkin, A. K. (Inst. of General and Inorganic Chemistry, Moscow). Zh. Neorg. Khim., 11: 2608-13(Nov. 1966). (In Russian).

The infrared absorption spectra of $Th(SO_3)_2 \cdot 4H_2O$ and its thermal decomposition products were obtained at 400 to 4000 cm^{-1}. The spectrum of $Th(SO_3)_2 \cdot 4H_2O$ can be interpreted if it is assumed that in the compound there are bidentate or bridge sulfite groups, the state of which is intermediate between the states of typical coordination and ionic SO_3 groups, but nearer to the ionic form; the water molecules participate in the formation of hydrogen bonds. (tr-auth).

25852 THORIUM COORDINATION CHEMISTRY. Molodkin, A. K.; Ivanova, O. M. Zh. Neorg. Khim., 11: 2456-77(Nov. 1966). (In Russian).

The characteristics of Th as a central atom and its stereochemistry were examined. Data showed that Th is characterized by the following: relative stability of the valence 4, variability of the coordination number generally and in coordination of one and the same ligands, formation of different polyhedrons for one and the same coordination number, tendency to a high coordination number (eight to nine and higher), as a result of the expandability of the chain and laminar structure. Even at the boundary of one coordination sphere different forms of the ligand bond with the central atom and marked oscillation of the Th–ligand distance can be observed. Analogies in the chemical behavior of Th, Ti, Zr, Hf, and the tetravalent actinides U, Np, and Pt were examined. It was shown that the characteristics of the stereochemistry of Th and its chemical analogs are inherent. (tr-auth).

25853 REACTIONS WITH THIOCYANATE ION SUBSTITUTION IN TETRACID-TYPE URANYL OXALATE COMPOUNDS. Shchelokov, R. M.; Shul'gina, I. M.; Chernyaev, I. I. (Inst. of General and Inorganic Chemistry, Moscow). Zh. Neorg. Khim., 11: 2652-61(Nov. 1966). (In Russian).

The substitution of water groups in uranyl oxalate compounds of the tetracid type for thiocyanate ions led to the formation of mixed thiocyano oxalato complexes of the pentaacid type with the composition $M_3[UO_2(C_2O_4)_2(NCS)]$; the concentration of the reacting components and the nature of the extraspherical cations affected the course of the reaction. The individual anions $[UO_2(C_2O_4)_2(NCS)]^{3-}$, probably mononuclear pentacoordination complexes, were formed. The formation of thiocyano oxalato uranate ions during the reaction of triaquo oxalate uranyl with salts of thiocyanic acid depends on the concentration of the latter in the solution and arises as a result of the dismutation of the diaquo thiocyano oxalato uranylate. (tr-auth)

25854 MECHANISM OF ISOTOPIC HYDROGEN EXCHANGE OF SEC BUTYLTRIFLUOROACETATE. Setkina, V. N.; Bykova, E. V.; Ginzburg, A. G.; Kursanov, D. N. (Inst. of Elementary Organic Compounds, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 170: 1344-7(Oct. 21, 1966). (In Russian).

It was found earlier that sec-butyl trifluoroacetate enters into an isotopic exchange reaction with deuterium-enriched trifluoroacetic acid, if sulfuric acid is added to the system. The mechanism of this reaction was further examined, carrying it out in the presence of bromine. It was found that the formation of 1,2- and 2,3-dibromobutanes competes with the hydrogen exchange, forming intermediary butenes from the carbonium ion. A protium-rich ester was found to be the chief intermediate compound. Two stages of the proposed reaction mechanism, the formation of an olefin and of the carbonium ion, could be demonstrated directly. The individual products were identified by gas-chromatographic measurements. (TTT)

25855 THEORETICAL ANALYSIS OF OSCILLATIONS OF URANYL COMPLEXES OF UO_2X_4 TYPE WITH TETRAGONAL BASE IN EQUATORIAL PLANE. Kharitonov, Yu. Ya.; Knyazeva, N. A. (Inst. of General and Inorganic Chemistry, Moscow). Zh. Neorg. Khim., 11: 2700-12(Dec. 1966). (In Russian).

A theoretical analysis of oscillations of UO_2X_4-type uranyl complexes with a tetragonal base in the equatorial plane showed that oscillations with $\nu_s(UO_2)$ (frequency) are characteristic for the uranyl group in their form and frequencies. However, the oscillations with $\nu_{as}(UO_2)$ are also characteristic in their frequency but not in their form. The frequency of the uranyl-group oscillations, in particular the $\nu_{as}(UO_2)$, could be used for comparing characteristics of uranyl-group states only in the case when the difference between them was less than about 10 to 15 cm^{-1}. (R.V.J.)

25856 THEORETICAL ANALYSIS OF THE OSCILLATION OF URANYL COMPLEXES WITH FOUR DISSIMILAR LIGANDS IN EQUATORIAL PLANES. Kharitonov, Yu. Ya.; Knyazeva, N. A. (Inst. of General and Inorganic Chemistry, Moscow). Zh. Neorg. Khim., 11: 2713-24(Dec. 1966). (In Russian).

A theoretical analysis was made of the oscillation of models of all possible uranyl complexes with four dissimilar ligands in equatorial planes. It was shown that a change of symmetry of the complexes of leaves practically unaltered the character of the valence oscillation of the uranyl group, which made it possible to extend the results obtained for complexes of the type UO_2X_4 to all uranyl complexes with four ligands in the equatorial plane. (tr-auth)

25857 PHYSICAL PROPERTIES OF HEAVY-OXYGEN WATER. PART 2. VAPOUR PRESSURE. Szapiro, S.; Steckel, F. (Weizmann Inst. of Science, Rehovoth, Israel). Trans. Faraday Soc., 63: 883-94(Apr. 1967).

A method was developed for measuring small differences between the vapour pressures of two samples. Vapor-pressure differences were determined between water samples with a high concentration of ^{18}O ($H_2{}^{18}O$ and $D_2{}^{18}O$) and samples with a low concentration, in the temperature range from 15 to 90°C. Differences between the vapour pressures of water containing ~55% ^{17}O and samples containing high concentrations of ^{16}O and ^{18}O respectively, in the range from 40 to 90°C, were also measured. Using these results, vapour pressure ratios between the pure isotopic species were calculated. (auth)

25858 SECONDARY DEUTERIUM ISOTOPE EFFECTS IN ISOTOPE EXCHANGE REACTIONS WITH BENZYL CHLORIDE. Strecker, H.; Elias, H. (Technische Hochschule, Darmstadt, Ger.). Radiochim. Acta, 7: 22-5(Mar. 1967). (In German).

In measuring the isotope exchange between benzyl chloride or d_7-benzyl chloride, both marked with ^{36}Cl and chloride ions in dimethylformamide a kinetic isotopic effect $k_H/k_D = 1.08_4 \pm 0.012$ was measured at a temperature of 35.0°C. (auth)

25859 HETEROGENEOUS ISOTOPIC EXCHANGE IN GAS CHROMATOGRAPHIC COLUMNS. Krutzik, S.; Elias, H. (Technische Hochschule, Darmstadt, Ger.). Radiochim. Acta, 7: 26-9 (Mar. 1967). (In German).

Labeling of volatile compounds by heterogeneous-isotopic exchange with non-volatile compounds in gas chromatographic columns is discussed on a general basis. The applicability of sodium iodide, potassium iodide, and silver iodide as stationary phases for labeling of organic iodides is investigated. (auth)

25860 LABELING ALIPHATIC HALIDES IN GAS CHROMATOGRAPHIC COLUMNS. Krutzik, S.; Elias, H. (Technische Hochschule, Darmstadt, Ger.). Radiochim. Acta, 7: 33-9(Mar. 1967). (In German).

Volatile aliphatic halides (mobile phase) can be labeled by isotopic exchange with non-volatile ionic halides (stationary phase) in gaschromatic columns at about 100 to 130°C. The low-melting salts tetrabutylammonium chloride, tetrabutylammonium bromide, and tetrabutylammonium iodide are particularly suitable as stationary phases. The isotopic exchange is complete and reversible. (auth)

25861 MAGNETIC SUSCEPTIBILITY OF SOLID SOLUTIONS $U(C_2O_4)_2.2H_2O$–$Th(C_2O_4)_2.2H_2O$. Aminov, T. G.; Evdokimov, V. B.; Zelentsov, V. V. (Moscow State Univ.). Dokl. Akad. Nauk SSSR, 170: 615-17(Sept. 21, 1966). (In Russian).

The magnetic susceptibility of uranium oxalate dihydrate dissolved in isomorphic and diamagnetic thorium oxalate dihydrate was investigated. Solid solutions of the two heavy-metal oxalates were prepared by heating the hexahydrated solid solutions to 105°C. The Faraday method was used for determining the magnetic susceptibility; measurements were carried out at temperatures between 79 and 195°K in helium between 2 and 5 mm of Hg. Results indicate an interaction between tetravalent uranium ions. On the basis of the effective magnetic moment data and the magnetic susceptibility of the U(IV) ions, and taking into account the similarity between magnetic properties of this system and those of the UF_4–ThF_4 system, it was concluded that 6d electrons are present in the U(IV) ions. However, the $5f^2$ electron configuration must be preferred, if it is assumed that the Hutchinson and Candela spin model is applicable for the uranium oxalate dihydrate. (TTT)

25862 STRUCTURE OF URANYL NITRATE HEXAHYDRATE AS INVESTIGATED BY MEANS OF PROTON MAGNETIC RESONANCE. Vdovenko, V. M.; Aleksandrov, N. M.; Sokolov, A. P.; Shcherbakov, V. A. (Leningrad State Univ.). Dokl. Akad. Nauk SSSR, 170: 618-21(Sept. 21, 1966). (In Russian).

The structure of uranyl nitrate hexahydrate powder and single crystals was studied by PMR to determine the direction of the proton-proton vectors and the state of the water molecules. Results on powder samples show that the protons possess a high mobility in the $UO_2(NO_3)_2 \cdot 6H_2O$ lattice. Below 100°K, the value of the second moment, $_\Delta H^2$, is constant and possesses a value of 28.0 ± 0.7 $gauss^2$. The data on the direction of the p–p vectors confirmed earlier results by neutron diffraction for the H_2O molecules solidly attached to the lattice at room temperature. It is concluded that two types of water molecules are present in the compound, exhibiting different mobilities of the p–p vectors at room temperature: two water molecules are located at the internal coordination sphere of the uranyl ion and four are outside the sphere. Similar results were obtained earlier in a narrower temperature range during a study of the nuclear resonance of $K_4Fe(CN)_6 \cdot 3H_2O$. (TTT)

25863 SURFACE CHEMISTRY AND VISCOSITY OF THORIA SOLS. McCorkle, Kenneth Hall Jr. Knoxville, Tenn., Univ. of Tennessee, 1966. 343p.

Thesis.

The morphology of colloidal thoria particles was determined by x-ray line broadening and electron photomicrography. Hydrous thoria was noncrystalline when first made and consisted of filaments 4 to 20 Å wide by 700 Å long and of spherical agglomerates of these strings. Amorphous thoria crystallized spontaneously over a period of weeks to make centrosymmetric particles. Crystalline colloidal thoria particles in sols consisted of single crystallites agglomerated weakly into elongated flocs. Adsorption data and electron photomicrography are consistent with the hypothesis that the crystallites are irregular cuboctahedra with both (111) and (100) faces developed about equally. The structure of thoria made by firing thorium oxalate was studied by pore condensation of adsorbed nitrogen. The data are consistent with the individual centrosymmetric crystallites being organized into thin parallel sheets within the relic particle. The entire surface of the individual crystallite of colloidal thoria is accessible for adsorption if the maximum firing temperature in preparation does not exceed 800°C. Thoria surface has a capacity of 5.7×10^{-6} $moles/m^2$ for adsorption of HNO_3, which is half of the capacity expected from density of surface thorium ions of cuboctahedral crystal faces. It is hypothesized that the discrepancy is due to steric hindrance of adsorbed nitrate. Adsorption of atmospheric CO_2 was a severe interference in HNO_3 adsorption measurements, and probably is the origin of the discrepancies of the foregoing capacity with other published values. The free energy of desorption of HNO_3 on thoria was variable, ranging from +10 kcal/mole at 0.007 mole ratio of adsorbed nitrate surface thorium ions to +5 kcal/mole at 0.48 mole ratio. The free energy is relatively constant in the mid range of the adsorbed acid to surface sites mole ratio. Variation in surface free energy is ascribed to differences in intrinsic energies of adsorption sites at low coverages but is tentatively hypothesized as being due to steric factors at high coverages. Data on HNO_3 adsorption versus temperature permitted estimating the enthalpy of desorption to be +7 to +8 kcal/mole, and with the free energy the entropy of desorption was estimated to be +9 eμ. This low entropy change implies little loss of freedom of an adsorbed surface nitrate. The suspension effect exerted by thoria sol on the junction diffusion potential at a KCl salt bridge was found to obey the ideal Donnan Equilibrium with all the adsorbed ion contributing. This result is discrepant with respect to published electrophoretic data for thoria, which places most of the adsorbed HNO_3 in the Stern Layer instead of the Gouy Layer. Properties of thorium nitrate solutions determined are density, viscosity, conductance, and pH. A conductance of 72 mho-cm/equiv was determined for the Th^{4+} ion at 25°C. (Diss. Abstr.)

25864 PROCESS FOR THE PREPARATION OF ZIRCONIUM COMPOUNDS AND PRODUCTS RESULTING THEREFROM. **Fehr, Bernard Henri Paul; Gascon, Joseph** (to Fabriques de Produits Chimiques de Thann et de Mulhouse). British Patent 1,060,223. Mar. 1, 1967. Priority date July 9, 1963, France.

A process for preparing zirconium compounds, particularly basic $Zr(SO_4)_2 \cdot 4H_2O$, from a sintered mass of $ZrSiO_4$ and Na_2O, comprises suspension of the ground mass of $SiO_2 \cdot ZrO_2 \cdot Na_2O$ in water and adding HCl to a pH between 0.4 and 0.7. The insoluble residue is separated and the solution is diluted to a content of 25 to 30 g/l of Zr calculated as ZrO_2. Either H_2SO_4 or $Na_2SO_4 \cdot 10H_2O$ or a mixture of the two is added to bring the pH of the solution to between 0.75 and 1.2. Fluoride and sulfate ions are added to assist in freeing the precipitate from SiO_2. The solution is heated to 35 to 45°C to precipitate $ZrSO_4$ which is washed by decantation to a purity of 99% $ZrO_2 + HfO_2$ and may then be calcined to ZrO_2 or converted to other zirconium salts. (P.G.C.)

25865 INTERNATIONAL SYMPOSIUM ON MACROMOLECULAR CHEMISTRY, PRAGUE, 1965. PART 1. Held Under the Auspices of the International Union of Pure and Applied Chemistry, Prague, August 30–September 4, 1965. J. Polym. Sci. Pt. C, No. 16, 1-619(1967). (CONF-650801).

Fifty-seven papers presented at the conference are included. Topics covered include: polymer degradation, molecular weight distributions of polymers, polymerization, chain scission and crosslinking, polyamides, viscosity of polymers, streaming birefringence, polymer solutions, crystallization in polymers, structure of polymers, interactions of macroradicals in polymers diene polymers, and various properties of polymers. A separate abstract was prepared for one paper. (M.C.G.)

For an abstract of the individual paper see: 25923.

25866 IMPROVEMENTS IN OR RELATING TO ISOTOPIC EXCHANGE PROCESSES. Poole, Keith Roderick (to United Kingdom Atomic Energy Authority). British Patent 1,066,470. Apr. 26, 1967. Filed Mar. 10, 1965.

A process is provided for production of deuterium-enriched materials by a dual temperature ammonia-hydrogen exchange in which a stream of hydrogen gas from the hot tower is cooled prior to being passed to the cold tower. Thus the ammonia vapor contained in the hydrogen stream is condensed. The process is characterized by the cracking of this condensed ammonia so that a mixture of H_2 and N_2 results. The mixture of gases is cooled and passed in isotope exchange relationship with a stream of liquid NH_3 in the cold exchange tower of the dual temperature system. The NH_3 vapor condensed from the H_2 stream is heated and passed into the NH_3 cracker. (B.L.M.)

25867 COMPLEXES OF THE RARE EARTHS. Sinha, Shyama P. New York, Pergamon Press, 1966. 210p.

In this discussion of the chemistry of rare earth complexes, topics treated are: coordination through nitrogen, oxygen, and both oxygen and nitrogen of the donors; coordination through atoms other than nitrogen and oxygen; spectral characteristics of rare earths and their complexes; luminescence of rare earths in chelates and in different environments; laser and applicability of rare earths as laser materials; and rare earths and the actinides. (J.G.B.)

Radiation and Nuclear Chemistry

Refer also to abstracts 25800 and 26877.

25868 (AEET-274) COMPATIBILITY STUDIES ON "APCODUR-22 WHITE": AN EPOXY BASED PAINT. Rao, M. H.; Shastry, L. V.; Srivastava, S. B.; Rao, K. V. S. Rama. (Atomic Energy Establishment, Trombay (India). Chemistry Div.). 1967. 14p. Dep.

Detailed compatibility studies were made on Apcodur-22 White, an epoxy-base paint, with a view to assessing its suitability for use on the lid of Zerlina, which is a low energy swimming pool type reactor. Paint samples in contact with water were found to be stable up to 5×10^5 RADs and as such could be used safely below this dose only. However, the residual solvents (air drying even for 12 weeks did not make it free of solvents) are capable of getting autoxidized and decrease the pH even in the absence of a radiation field. In the presence of radiation (~10^4 RADs) this oxidation is further accelerated. In both cases the final pH is estimated to be 4. Application of Apcodur-22 White to the lid of Zerlina seriously affected the isotopic purity and pD (or pH) of D_2O. However, this handicap can be overcome by pre-equilibrating the paint with D_2O. (P.C.H.)

25869 (EUR-3172.e) THE RADIOLYTIC AND PYROLYTIC DECOMPOSITION OF ORGANIC COOLANTS. III. THE RADIOLYSIS AND PYROLYSIS OF m-TERPHENYL AND m-TERPHENYL-d_{14}. Juppe, G.; Rau, H.; Dorpema, F. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Mar. 1967. 38p. Dep.

Both the radiolysis and the pyrolysis of unlabeled m-terphenyl and m-terphenyl-d_{14} were investigated. A comparison of the kinetics of pyrolysis showed that the deuterated compound suffered lower destruction of the starting material than did the m-terphenyl. Furthermore, less hydrogen and aliphatic hydrocarbons, benzene, biphenyl, quaterphenyls, triphenylbenzenes and triphenyl, and high boilers were formed with the deutrated compound. The reaction orders for the decomposition of the starting terphenyls as well as for the formation of the reaction products were determined. The quantitative differences in the reaction rates and the composition of the pyrolysis products are attributed to a small difference in the bond dissociation energy between the aromatic CH- and CD-bonds, which leads to a primary isotope effect in the homolytic rupture of these bonds. The radiolysis of unlabeled m-terphenyl and m-terphenyl-d_{14} by 2-MeV electrons also showed a greater stability of the deuterated terphenyl. A lower rate of m-terphenyl-d_{14} destruction was observed. The formation of quinqua + hexaphenyls and highboilers was also found lower for the labeled compound. The reaction mechanism of the radiolytic decomposition of aromatic hydrocarbons is discussed. (auth)

25870 (EUR-3287.e) THE RADIOLYTIC AND PYROLYTIC DECOMPOSITION OF ORGANIC COOLANTS. II. THE POST-PYROLYSIS OF PREIRRADIATED OM2. Juppe, G.; Wedekind, G.; Rau, H.; Schuetz, G. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Mar. 1967. 24p. Dep.

The postpyrolysis of in-pile-irradiated terphenyls (OM2) causes a higher rate of decomposition than the pyrolysis of unirradiated material. A higher formation of gaseous hydrocarbons, benzene, diphenyl, and higher boiling aromatic compounds is also observed. The kinetics of the decompositions are described. The possible mechanisms responsible for the observed differences of reaction rates and product compositions are discussed. (auth)

25871 (IS-T-118) RECOIL CHEMISTRY OF ^{11}C IN C_5 HYDROCARBONS, FRAGMENTATION, AND STABILIZATION. Jewett, Gary Lew (Ames Lab., Iowa). Feb. 1967. Contract W-7405-eng-82. 80p. Dep. CFSTI.

Thesis.

The chemical behavior of carbon-11 atoms produced by the $^{12}C(\gamma,n)^{11}C$ process was studied by the use of radio-gas chromatography. The compounds isopentane, n-pentane, pentene-1, cyclopentane, cyclopentene, and benzene were irradiated with 70-MeV bremsstrahlung and the yields of labeled products containing one to six carbon atoms were determined. In the cyclopentene system, the yields of methane, ethane, ethylene, and acetylene were studied as a function of dose. These yields did not vary, indicating that the cyclopentene may have been acting as a scavenger. The yields of products in unscavenged systems did not total 100 percent, and the total yields were less for unsaturated than for saturated systems. In the isopentane system, part of the missing activity was found as products containing eleven carbon atoms. This indicated that in some cases the carbon atom reacts with two molecules of the parent compound. The only time a strict statistical distribution of products was found was in the n-pentane plus iodine system. The absolute yields of n-hexane : 2-methylpentane : 3-methylpentane were found as 6.69 : 4.17 : 1.98 with the expected ratios being 6 : 4 : 2. The product distributions are discussed in terms of the insertion reactions of ^{11}C, ^{11}CH, and $^{11}CH_2$. (P.C.H.)

25872 (N-67-11725) METHODS OF FORMATION OF THE NITROSO GROUP AND ITS FORMATIONS. Boyer, J. H. (Illinois Univ., Chicago). [1966]. 154p. (NASA-CR-79491). CFSTI $3.00 cy, $0.65 mn.

Extensive data are presented on the chemistry of the C-nitroso compounds. Several preparative methods are discussed, including irradiation of nitrosyl halide with alkanes. Structures and reactions are also considered. (TSS)

25873 (NYO-3383-06) STUDIES IN CHEMICAL RADIATION PROTECTION AGENTS. Comprehensive Report, May 1, 1964–March 22, 1967. Trumbore, C. N. (Delaware Univ., Newark. Dept. of Chemistry). Feb. 14, 1967. Contract AT(30-1)-3383. 13p. Dep. CFSTI.

The radiolysis of cysteine was studied in an attempt to better understand the mechanism of protective agents in biological systems. The effects of pH, cysteine concentration, added O_2, and certain added radical scavengers were also studied. The primary products of aqueous cysteine (RSH) solutions were found to be H_2, H_2S, cystine, H_2O_2, and alanine. These yields were found to depend upon pH, O_2, and certain regions, upon RSH concentration. A mechanism for the radiation chemistry of deaerated aqueous, acidic solutions of cysteine at concentrations of 10^{-3} $\underline{M}$ and above is postulated. Dimethylcysteine, a poor protective agent, showed quantitative differences between its radiation chemistry and that of cysteine. Pulse radiolysis studies on other aqueous solutions are described briefly. (P.C.H.)

25874 (ORO-2945-8) RADIATION INDUCED POLYMERIZATION OF VINYL MONOMERS IMPREGNATED IN WOOD. Kent, J. A.; Taylor, G. B.; Boyle, W. R.; Winston, A. W. (West Virginia Univ., Morgantown). Dec. 8, 1966. Contract AT(40-1)-2945. 17p. (CONF-661201-3). Dep. CFSTI.

From American Inst. of Chemical Engineers Symposium, Detroit.

The effects of radiation intensity on conversion rates and the quantity of radiation required for complete polymerization of monomers in wood were investigated. The monomers used were methyl methacrylate, ethyl acrylate, styrene, acrylonitrile, and ethyl acrylate–acrylonitrile, styrene–acrylonitrile, and Phosgard–methyl methacrylate systems. The results indicated that the gamma radiation dose required for complete polymerization of the monomer systems studied in a variety of woods was a function of the 0.3 power of radiation intensity. However, with pine resins an inhibitory effect was found. (P.C.H.)

25875 (PRNC-99) MATRIX ISOLATION STUDIES OF PRODUCTS OF γ-RADIOLYSIS OF HETEROCYCLIC MOLECULES. Progress Report No. 2, Fiscal Year 1967. Grimison, Alec (Puerto Rico Nuclear Center, Mayaguez). Contract AT(40-1)-1833. 37p. Dep.

Developments in experimental and theoretical studies on the gamma radiolysis of heterocyclic molecules in Freon and methyltetrahydrofuran matrices are reported. Results for pyrrole and pyridine in Freon glass were interpreted by assigning the absorption maxima at 800 and 380 mμ tentatively to the pyrrole radical cation and the pyridine radical cation, respectively. Thus the increase in these bands on bleaching the solvent positive centers indicates that these species are either cationic, or have cationic precursors. Furan and thiophene also gave absorption maxima at 710 and 830 mμ, respectively, in Freon glass. Explanations are given for the decrease observed in the absorption of other heterocyclic molecules on bleaching in Freon glass. Molecular orbital and valence bond calculations are given. (P.C.H.)

25876 PRODUCTION OF GRAFT COPOLYMERS BY IRRADIATION OF MIXTURES OF POLYOXYETHYLENE [GLYCOL] AND STYRENE. Wagner, Joseph; Marchal, Jean (Centre de Recherches sur les Macromolecules, Strasbourg). Compt. Rend., Ser. C., 264: 1263-6(Apr. 10, 1967). (In French).

Graft copolymers can be obtained by irradiation of degassed mixtures of a vinyl polymer and a vinyl monomer. It was found that this procedure gives satisfactory results when it is applied to a mixture of polyoxyethylene [glycol] and styrene. Some preliminary results are given concerning a study of the yield of the reaction as a function of the temperature of irradiation and the composition of the irradiated mixtures. (tr-auth)

25877 RADIATION EFFECTS ON TRIGLYCERIDE. Fukada, Eiichi (Inst. of Physical and Chemical Research, Tokyo); Masuzawa, Mitsunobu. J. Amer. Oil Chem. Soc., 43: 657-60 (Dec. 1966).

Some radiation effects on glyceryltristearate and glyceryltrioleate are reported. Electron-beam radiation, with an energy of 1.5 MeV, from a Van de Graaff accelerator was used to treat the specimens in air with doses up to 900 MRAD. Differential thermal analysis (DTA) and x-ray diffraction measurements were used for determining changes in physical properties of irradiated triglycerides. Measurements of intrinsic viscosity and solubility of solutions of the irradiated specimens were also carried out to investigate the chemical changes introduced in molecular structure. The DTA and x-ray diffraction results revealed that the degree of crystallinity decreased with radiation dose after an initial small rise and that the unstable forms in crystal modification were increasingly stabilized. Measurements of intrinsic viscosity and gel fraction for solutions of tristearin and triolein showed that the gel formation took place at about 700 and 350 MRAD, respectively. The number of unsaturated bonds, determined by iodine absorption, increased with radiation dose in tristearin but decreased in triolein. (BBB)

25878 RADIATION CHEMISTRY OF PLUTONIUM NITRATE SOLUTIONS. Miner, F. J.; Seed, J. R. (Dow Chemical Co., Golden, Colo.). Chem. Rev., 67: 299-315(June 1967).

Since the products from radiolysis of water and of nitrate play an important role in determining the chemistry of plutonium in nitrate solutions, the radiolytic chemistry of aqueous nitrate solutions is discussed. The majority of stable plutonium isotopes are α emitters, therefore, the discussions are primarily directed at an understanding of α-induced reactions of water and the nitrate ion. Radiation effects the chemistry of plutonium in aqueous nitrate solutions primarily by the production of oxidizing and reducing agents, which subsequently react with plutonium. Mechanisms of the oxidation–reduction reactions of plutonium in nitric acid solutions and the influence of solution parameters on these reactions are considered. (D.H.M.)

25879 INVESTIGATIONS IN THE FIELD OF RADIATION-INDUCED SOLID-STATE POLYMERIZATION. XVIII. MONOALLYL NORBORNENEDICARBOXYLATE AND SOME OF ITS BINARY SYSTEMS. Hardy, Gy.; Nyitray, K. (Research Inst. for Plastics, Budapest). Acta Chim. Acad. Sci. Hung., 52: 105-13(1967).

The solid-state polymerization of monoalloy norbornenedicarboxylate was investigated. The polymerization takes place by reaction of the allyl groups up to 20% conversion; at higher conversions an insoluble polymer is formed owing to participation of double bonds in the cycle of the monomer. The binary system consisting of monoallyl and monopropyl norbornenedicarboxylate gives an isomorphous solid solution. The propyl ester acts as physical barrier in the solid-state polymerization of the allyl ester; an increase of the concentration of the propyl ester results in a monotonous decrease of the rate of polymerization. The binary systems consisting of monoallyl ester and acetanilide, succinimide, and naphthalene, respectively, are characterized by the formation of eutectic mixtures. The characteristics of the solid-state polymerization of these binary systems indicate the formation of quasi-eutectic structures, namely the physical structures of the solid systems depend to a large extent on conditions of the cooling and crystallization processes. (auth)

25880 MOLECULAR WEIGHT CHANGES IN IRRADIATED POLYPROPYLENE. Marans, N. S.; Zapas, L. J. (Washington Research Center, Clarksville, Md.). J. Appl. Polym. Sci., 11: 705-18(May 1967).

Two separate measurements showed that polypropylene when melted after irradiation undergoes crosslinking from the inception of irradiation. The first proof was an immediate increase in the solution viscosity of a narrow molecular weight fraction of polypropylene. The second proof was the marked change in melt-flow properties on irradiation of a broad molecular weight distribution polypropylene. These findings tend to support one of the two currently held views on the action of radiation on polypropylene. It was confirmed that melting after irradiation contributes to the overall crosslinking reaction. (auth)

25881 RADIATION POLYMERIZATION OF N-HYDROXYMALEIMIDE. Ivanov, V. S.; Smirnova, V. K.; Yung, Tsao (Leningrad State Univ.). Vysokomol. Soedin., 9: 899-903(Apr. 1967). (In Russian).

N-hydroxymaleimide was polymerized in dimethylformamide (DMFA) solution at 20°C by γ-irradiation of ^{60}Co. The effects of dose, dose rate, monomer concentration, Santovar A, β-naphthylamine, and CCl_4 additives on polymerization were studied. In gaseous products formed at polymerization CO is found. The polymer is characterized by its solubility, intrinsic viscosity, softening, and decomposition temperature using x and ir techniques. (auth)

25882 EFFECTS OF X RADIATION ON THE STRENGTH STABILITY OF POLYMETHYL METHACRYLATE. Tynnyi, A. N.; Mikitishin, S. I.; Velikovskii, A. A.; Khomitskii, Yu. N.; Kolevatov, Yu. A. (Inst. of Physics and Mechanics, Lvov). Fiz.-Khim. Mekh. Mater., 3: No. 1, 42-5(1967). (In Russian).

The effects of x-irradiation on the resistance properties of polymethyl methacrylate (PMMA) in air and water media were studied under tension and tension-free. A significant weakening of PMMA began with a dose as low as 7×10^4 Joule/kg. The strength of PMMA was greater when under simultaneous tension and irradiated force. Results also showed that x radiation inhibits PMMA stability in water. (R.V.J.)

25883 PHOTOLYTIC TRANSFORMATION OF RADICALS IN GAMMA-IRRADIATED FROZEN AQUEOUS SOLUTIONS OF INORGANIC ACIDS. Ershov, B. G.; Pikaev, A. K. (Inst. of Physical Chemistry, Moscow). Dokl. Akad. Nauk SSSR, 169: 616-18 (July 21, 1966). (In Russian).

The EPR spectrum of radicals with properties depending on the anions of their acids and photolytic transformation induced into radicals by light were studied using frozen $HClO_4$, H_2SO_4, and H_3PO_4 solutions irradiated with ^{60}Co γ rays at a dose of $\sim 3 \times 10^6$ eV/ml sec and absorption dose of $\sim 5 \times 10^{19}$ eV/ml at −196°C. The irradiated frozen aqueous 5.6M solution of $HClO_4$ was colorless. It acquired brown color and additional lines when it appeared in large quantities or after absorbing large doses. The EPR spectra of the H_2SO_4 and H_3PO_4 were identical to the EPR spectrum of γ-irradiated $HClO_4$ except in the case of H_2SO_4 with the low-intensity additional signal which indicated that in this system ionizing radiation induces some radicals whose properties are not related to the anionic properties. (R.V.J.)

25884 STRUCTURAL ELUCIDATION OF ORGANIC COMPOUNDS BY ELECTRON "BURNING." PART 5. ELECTRON "BURNING" OF ALANINE, ASPARTIC ACID, PROLINE, AND INDOLYL-3-ACETIC ACID. Schildknecht, H.; Gessner, K. (Univ., Heidelberg). Z. Anal. Chem., 227: 338-52(1967). (In German).

By electron "burning" of amino acids a cleavage of the C−N bond takes place. With the radiolysis products of tritiated water H(T) and OH(OT) the resulting radical fragments are stabilized. In addition an oxydative cleavage transforming α-amino acids into α-keto acids was observed. Apart from decarboxylation a fragmentation of C−C bonds was detectable in special cases. Due to the different molecular structure of amino acids in aqueous solution fundamental differences against the mass spectroscopy are to be found in the course of electron "burning." The results of the γ- and x-ray radiolysis of aqueous solutions of amino acids are comparable with those of electron "burning." The fragments are similar to those found in biochemical degradation reactions. (auth)

25885 GAMMA RADIATION EFFECTS ON FREQUENCY OF OSCILLATIONS OF AT-CUT PIEZOQUARTZ PLATELETS. Starodubtsev, S. V.; Chubarov, L. B. (Inst. of Nuclear Physics, Tashkent). Dokl. Akad. Nauk Uz. SSR, No. 1, 22-3(1967). (In Russian).

The experiments showed that ^{60}Co γ irradiation from several megarads up to 1 to 2×10^{10} rads influenced about 0.01% of the oscillation frequency of AT-cut piezoelectric quartz plates. (R.V.J.)

25886 RADIATION-INDUCED POLYMERIZATION OF SOME RING COMPOUNDS IN THE LIQUID STATE. Ueno, Katsuji; Tsukamoto, Hiroshi; Hayashi, Koichiro; Okamura, Seizo (Kyoto Univ.). J. Polym. Sci., Pt. B, 5: 395-9(May 1967).

The effects of ^{60}Co γ-radiation on the polymerizability of several ring compounds in the liquid state were investigated. Propylene oxide, ethylene sulfide, 3,3-bis(chloromethyl)oxetane (BCMO), 1,3-dioxolane, trioxane, diketene, tetrahydrofuran, and β-propiolactone were used. Rate and degrees of polymerization were very low. G(-m) values were less than 10 and the polymers were oily, except ethylene sulfide. Diketene, β-propiolactone, and tetrahydrofuran were hardly polymerized. BCMO and trioxane were found very sensitive to water, polymerizing only after rigorous drying. A mechanism is offered. (P.C.S.)

25887 ELECTRON SPIN RESONANCE OF TRAPPED FREE RADICALS AND THE PHOTOINDUCED RADICAL CONVERSION IN γ-IRRADIATED ISOTACTIC POLYPROPYLENE. Iwasaki, Machio; Ichikawa, Takahisa; Toriyama, Kazumi (Government Industrial Research Inst., Nagoya, Japan). J. Polym. Sci., Pt. B, 5: 423-8(May 1967).

The photoinduced radical conversion in γ-irradiated isotactic polypropylene at 77°K was investigated. An interpretation of the resulting ESR spectra is proposed to explain disagreements with previous literature. (P.C.S.)

25888 ROLE OF PEROXIDES IN RADIATION OXIDATION OF POLYSTYRENE. Koritskii, A. T.; Zubkov, A. V. (Inst. of Physical Chemistry, Moscow). Vysokomol. Soedin., 9: 789-97(Apr. 1967). (In Russian).

The kinetics of oxygen accumulation and gaseous products evolution in irradiation of polystyrene with fast electrons ($E_e = 1.6$ MeV) at room temperature are discussed. Comparison with ESR data corresponding to low temperatures showed selective decomposition of admixtures in the samples and of the radiolysis products. Decomposition of the added peroxides in polystyrene increased the radiation yield of active particles, which accelerates oxidation in presence of oxygen in some cases. The absence of substantial dependence of radiation yield of gaseous products on temperature proves that decomposition proceeds on specific radiation mechanism of energy localization on admixture molecular (transfer of exitation energy, charge transfer). The conclusion is corroborated by ESR data. The acceleration of oxidation of pure polymer with dose is explained by formation of the products actively participating in the oxidation process. (auth)

25889 STUDY OF RADICALS IN IRRADIATED POLYETHYLENE IN CONNECTION WITH MECHANISM OF RADIATION POLYMERIZATION OF ETHYLENE. Gerasimov, G. N.; Khomikovskii, P. M.; Abkin, A. D. Vysokomol. Soedin., 9: 877-82(Apr. 1967). (In Russian).

Radicals in irradiated polyethylene were studied using ESR techniques under conditions close to radioinduced heterogeneous polymerization of ethylene. At 25°C and 60 atm pressure, alkyl radicals rapidly disappeared. In contrast to the recombination of radicals of the linear catalytic polymer, stable allyl- radical formation occurred in irradiated polyethylene. Both reactions proceed at polymerization conditions with comparable rates, which must be considered in analysis of kinetic data on radioinduced polymerization of ethylene to the solid polymer. (auth)

25890 PRESSURE DEPENDENCE OF G(CO_2) IN THE γ RADIOLYSIS OF CARBON MONOXIDE. Buschmann, H. W.; Groth, W. (Univ., Bonn). Z. Naturforsch., 22a: 141-2(Jan. 1967). (In German).

Studies on γ radiolysis of carbon monoxide showed that the G value of carbon dioxide formation is pressure dependent. The results of the measurement of G values at different pressures can be interpreted by two reaction mechanisms. In the first it is assumed that the carbon monoxide molecule does not react immediately after its excitation but goes first into a further excited state from which the reaction or dissociation follows. In the second mechanism the primary excited molecule reacts with carbon monoxide with the formation of excited double molecules; these can decay by carbon dioxide formation or be deactivated by collision. (J.S.R.)

25891 SOLID-STATE POLYMERIZATION OF 1,2,3,4-DIEPOXYBUTANE INITIATED BY ^{60}Co γ-RADIATION. Parrish, C. F.; Harmer, D. E. (Dow Chemical Co., Midland, Mich.). J. Polym. Sci., Pt. A-1, 5: 1015-20(May 1967).

The solid-state polymerization of 1,2,3,4-diepoxybutane appears to proceed "insource" by an ionic mechanism and has an overall activation energy of 0.4 kcal/mole with an intensity dependency of 0.99. There was a rapid increase in the rate of polymerization just prior to the melting point and a very low rate for the liquid-phase reaction. Limiting conversions of 5% polymer were observed at −196°C for irradiation in vacuo. No limiting conversion was observed when the monomer was polymerized in the presence of air or in vacuo at −78°C. Under all polymerization conditions the reactions were characterized by the absence of an induction period. (auth)

25892 MECHANISM OF INITIATION IN THE γ-RADIATION-INDUCED POLYMERIZATION OF ETHYLENE. Mitsui, Hiroshi; Machi, Sueo; Hagiwara, Miyuki; Kagiya, Tsutomu (Japan Atomic Energy Research Inst., Gunma). J. Polym. Sci., Pt. A-1, 5: 1073-82(May 1967).

The gaseous products formed by the γ irradiation of ethylene were studied under high pressure from 150 to 400 kg/cm^2. The effects of temperature and dose rate were also considered. The main gaseous products were hydrogen and acetylene, and the amounts of these products increased linearly with reaction time, monomer density, and dose rate, but were independent of reaction temperature. The rate of formation of hydrogen was half that of acetylene. Further, it was found that the number of moles of polymer chain formed was almost equal to that of acetylene at room temperature. An initiation mechanism in which both hydrogen and acetylene are formed is proposed. The equation, which is derived on the basis of the initiation mechanism, is shown to be in good accordance with the experimental results. (auth)

25893 ESR SPECTRA OF SOME IRRADIATED POLYCRYSTALLINE OXYCOMPOUNDS OF TELLURIUM. Constantinescu, O.; Pascaru, I.; Constantinescu, M. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys., 12: 223-4(1967).

Electron spin resonance spectra of γ-irradiated polycrystalline K_2TeO_4 and Na_2TeO_4 were studied at 77 and 300°K. At 77°K spectra from TeO^- prevailed; this signal diminished on heating and the prevailing species left was TeO_2^-. (M.C.G.)

25894 RADIATION POLYMERIZATION IN THE SOLID PHASE. Komurka, Milos (National Commission for Tech., Prague). Chem. Listy, 61: 41-57(1967). (In Czech).

Radiation polymerization in the solid phase is reviewed and several previously proposed mechanisms of radiation polymerization are discussed. Previously published results of radiation polymerization of a number of organic compounds are summarized. These compounds are classified into five groups based on relationship of the kinetics of the polymerization below and above the melting point of the monomer. Each of the five groups is characterized by a diagram of reaction velocity versus temperature as well as a brief description of the behavior. The mechanism and kinetics of radiation polymerization in the solid phase are considered to be poorly understood, and research in the role of crystal structure in radiation polymerization is said to be needed. (TTT)

25895 ELECTRON PARAMAGNETIC RESONANCE SPECTRA OF THE PYRIDINYL RADICAL IN THE SOLID PHASE. **Chachaty, Claude (CEN, Saclay, France). J. Chim Phys., 64: 608-13(Apr. 1967). (In French).**

The pyridinyl radical was produced by γ irradiation of solid solution of pyridine (C_5H_5N and C_5D_5N) in ethanol (C_2H_5OH and C_2D_5OD) at 77°K. Because of poor resolution of the ESR spectra recorded in those conditions, the hyperfine coupling constants were deduced from differences of overall width and second moments of spectra of the $\cdot C_5H_5NH$, $\cdot C_5H_5ND$, $\cdot C_5D_5NH$, and $\cdot C_5D_5ND$ radicals. The following coupling constants were found: $\alpha_N = 6.5$ gauss, $\alpha_{NH}^{H} = 7$ gauss, $\alpha_{H2} = 6$ gauss, and $\alpha_{H4} = 11$ gauss. The spin densities deduced from the experimental coupling constants were compared with those calculated by Hückel's method. (auth)

25896 RADIOLYSIS OF AQUEOUS SOLUTIONS OF SODIUM HYPOCHLORITE. **Julien, Renee; Pucheault, Jacques (Laboratoire Curie, Paris. Laboratoire de Synthese Atomique et d'Optique Protonique, Ivry-sur-Seine, France). J. Chim. Phys., 64: 725-35(Apr. 1967). (In French).**

Neutral solutions of hypochlorites irradiated by ^{60}Co γ rays were partly reduced to chloride and partly oxidized to chlorate, with simultaneous formation of hydrogen and oxygen. The influence of the following factors was examined: concentration of ClO^- ions, which might capture hydrated electrons that would otherwise lead to molecular H_2 and H_2O; the presence of H^+ ions, which might favor radiolytic acceleration of the thermal reaction $HClO + Cl^- \rightarrow Cl^2 + OH^-$; and the presence of OH^- ions, which gives rise to a dilution effect at pH 12.8, although the results obtained at the highest concentration of ClO^- were the same as in neutral solutions. It was found that the effect of ClO^- concentration may be due to the intervention of ClO^- in the spurs, catalyzing the recombination reaction $O^- + e_{aq}^- \rightarrow 2\ OH^-$, to a rate comparable with that of the reaction $OH + e_{aq}^- \rightarrow OH^-$; thus the radical and molecular yields determined for neutral media are not necessarily valid for dilute alkaline solutions in spite of the identical experimental yields. For neutral solutions: $G_{red} = G_e + G_H = 2.6$; $G_{OH} = 2.1$; $G_{H_2} = 0.45$; $G_{H_2O_2} = 0.7$. (auth)

25897 SECONDARY REACTIONS IN THE γ-RADIOLYSIS OF HYDROCARBONS WITH ELECTRON SCAVENGERS. Sagert, N. H.; Blair, A. S. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Chem., 45: 1351-6(June 15, 1967).

Secondary reactions in liquid-phase radiolysis of cyclohexane in the presence of N_2O and SF_6 were examined by determining yields of liquid products. When up to 0.3M N_2O was added, the hydrogen yield was reduced from its initial yield of 5.5 G units to 2.5 G units. The nitrogen yields were about twice the decrease in hydrogen yields. Bicyclohexyl and cyclohexene yields increased from their initial values to 2.2_7 and 3.5_0 G units, respectively. When up to 0.12$\underline{M}$ SF_6 was added, all the yields were decreased to about one half of their initial value. These results may be interpreted in terms of Dyne's general mechanism for the radiolysis of hydrocarbons if two cyclohexyl radicals are produced for every electron scavenged by N_2O, but if none are produced for electrons scavenged by SF_6. It is suggested that the total electron yield in pure cyclohexane is about 4.1 G units, of which only 3.0 G units produce hydrogen. The other 2.5 G units of hydrogen from the radiolysis of pure cyclohexane are presumed to arise from direct excitation. (auth)

25898 NUCLEAR RECOIL REACTIONS IN ORGANO-MANGANESE COMPOUNDS. II. METHYLCYCLOPENTADIENYL-MANGANESE TRICARBONYL. **Yang, I. C.; Wiles, D. R.** (Carleton Univ., Ottawa). **Can. J. Chem., 45: 1357-60(June 15, 1967).**

The study of nuclear recoil reactions in organomanganese compounds was continued in methylcyclopentadienylmanganese tricarbonyl, a liquid, following earlier conclusions that the recombination reactions may involve a radical diffusion mechanism. Only a very small annealing effect was observed, but that was similar to the earlier results in which a maximum organic yield is reached, followed by a return to the initial value. Results of irradiation in benzene solution showed no decrease of organic yield on dilution, which is interpreted as indicating that 'hot' reactions do not play a major role. Results of irradiation in mixed benzene–acetone solutions showed a sharp decrease in organic yield as small quantities of acetone were added, which suggests a radical-scavenging process. The observation made earlier that considerable $CH_3Mn(CO)_5$ is produced in this reaction led to the speculation that radicals of the form $Mn(CO)_x$ are the reacting species. (auth)

25899 ELECTRON PARAMAGNETIC RESONANCE SPECTRA STUDY OF THE RADICALS AND IONS PRODUCED BY GAMMA IRRADIATION AT 77°K OF ORGANIC GLASSES IN THE PRESENCE OF ELECTRON SCAVENGERS. **Chachaty, Claude (CEN, Saclay, France). J. Chim. Phys., 64: 614-26(Apr. 1967). (In French).**

The nature and yield of the radicals produced by γ irradiation at 77°K of electron scavenger solutions in four organic glasses, ethanol, tetrahydromethyl furan (THMF), 1,1-dimethoxymethane (DME), and methylcyclohexane (MCH), were studied by ESR. In nonhydroxylated polar glasses, the spectrum of anions produced by the scavenging of electrons was observed at 77°K, particularly $C_6H_6^-$ and $C_6H_5NO_2^-$, this last radical produced by warming the $C_6H_5\dot{N}O_2H$ radical which can be detected even at room temperature in the liquid phase. In ethanol most of the aromatic compounds (ArH) gave, by irradiation at 77°K, the radicals resulting from hydrogen addition to a double bond, probably being formed by $ArH^- + C_2H_5OH \rightarrow ArH_2^{\cdot} + C_2H_5O^-$, after electron capture by the aromatic hydrocarbon. In the case of biphenyl anion this reaction was actually observed between 90 and 110°K. Among aromatic compounds studied, only the biphenyl gave a stable anion at 77°K by γ irradiation in MCH. Several reactions of dissociative electron capture by compounds such as CCl_4 and $C_6H_5CH_2Cl$ were also studied. The yields from these last reactions are in agreement with these deduced from the other type of reaction; $G\ (e^-) = 3 \pm 0.2$ for ethanol and THMF; 1 ± 0.2 for DME; and 0.5 ± 0.1 for MCH. (auth)

25900 ISOTOPIC EFFECT AND THE EFFECT OF PHASE IN ETHYL BROMIDE IRRADIATED BY SLOW NEUTRONS. **Milman, Miriam (Facultes des Sciences, Orsay, France. CEA, Saclay, Gif-sur-Yvette, France). J. Chim. Phys., 64: 658-64 (Apr. 1967). (In French).**

The chemical effects of the $^{79}Br(n,\gamma)^{80m}Br$ and ^{82m}Br (isomeric transition), ^{82}Br reactions were studied in irradiated ethyl bromide in liquid and solid phase. The correlation found between the isotope and phase effects helps to explain the activation mechanisms. (auth)

25901 SPEEDS OF REACTION OF THREE NITROPARAFFINS WITH HYDROGEN ATOMS AND SOLVATED ELECTRONS IN AQUEOUS MEDIUM. **Sutton, Jack; Tran Dinh Son (Centre d'Etudes Nucleaires, Saclay, France). J. Chim. Phys., 64: 688-90(Apr. 1967). (In French).**

Rate constants were measured for reactions of the first three n-nitroparaffins with hydrogen atoms and solvated electrons formed in the radiolysis of water. The values obtained for reaction with H are: $k_{CH_3NO_2} = 4.25 \times 10^7\ M^{-1}s^{-1}$, $k_{C_2H_5NO_2} = 4.40 \times 10^7\ M^{-1}s^{-1}$, $k_{C_3H_7NO_2} = 4.6 \times 10^7\ M^{-1}s^{-1}$; and for reactions with solvated electrons: $k_{CH_3NO_2} = 2.86 \times 10^{10}\ M^{-1}s^{-1}$, $k_{C_2H_5NO_2} = 2.71 \times 10^{10}\ M^{-1}s^{-1}$, and $k_{C_3H_7NO_2} = 2.72 \times 10^{10}\ M^{-1}s^{-1}$. (auth)

25902 INFLUENCE OF PHASE ON THE CHEMICAL BEHAVIOR OF ^{132}I FORMED BY DISINTEGRATION OF ^{132}Te IN ORGANIC MEDIUM. II. SOLUTIONS OF $^{132}TeCl_4$ AND $(C_6H_5)_2{}^{132}Te$ IN BUTANOL. **Llabador, Y.; Adloff, J. P. (Centre de Recherches Nucleaires, Strasbourg). Radiochim. Acta, 7: 20-2(Mar. 1967). (In French).**

The yields of ^{132}I-labeled iodobenzene and alkyl iodides formed on disintegration of ^{132}Te in liquid and solid solutions of $TeCl_4$ and $(C_6H_5)_2$ Te in butanol were determined. An important phase effect was found in the case of diphenyltellurium. Results are interpreted on the basis of the autoirradiation model. (auth)

25903 UNCHARGED FRAGMENTS FROM SIMPLE AROMATIC MOLECULES IN ELECTRON COLLISIONS. **Genzel, H.; Osberghaus, O. (Univ., Bonn). Z. Naturforsch., 22A: 331-4 (Mar. 1967). (In German).**

A mass spectrometer was used to study the primary neutral fragments produced by 200-eV electrons from C_6H_6, C_6H_5F, and $C_6H_5CH_3$ at pressures of 10^{-5} torr. In the case of C_6H_6 an attempt was made to measure quantitatively the relative production rates of different neutral fragments and to determine the relative importance of ionic and neutral decays. Ionization potentials of C_6H_5, C_6H_4, and C_6H_2 were measured. (auth)

25904 AN ELECTRON SPIN RESONANCE STUDY OF γ-IRRADIATED POLYCRYSTALLINE n-PROPANEARSONIC ACID. Cadena, D. G. Jr.; Rowlands, J. R. (Southwest Research Inst., San Antonio, Tex.). J. Chem. Soc. (B), No. 5, 506-8(1967).

An electron spin resonance study of three radicals identified in a γ-irradiated polycrystalline sample of n-propanearsonic acid is reported. One of the radicals identified exhibited hyperfine interaction to a β-arsenic atom. (auth)

25905 DEVELOPMENT OF POLY(VINYLCHLORIDE)-INSULATED ELECTRIC WIRES USING ELECTRON-BEAM IR-

RADIATION. Izumi, Masahiro; Suzuki, Fumio; Yuri, Tooru **Sumitomo Elec. Tech. Rev., No. 9, 50-6(Mar. 1967).**

Choosing the proper irradiation conditions for improving the properties of PVC by irradiation is discussed. Several experimental results concerning the crosslinking effects by different irradiation such as atmosphere, radiation source, and PVC compositions (crosslinking agent, polymer, stabilizer, plasticizer, fillers, etc.) are discussed. From these results, electrical wires insulated with irradiated crosslinked PVC were produced and tested. Improved properties of the wires are as follows: heat resistance property; non-solvent property for chemical agents; and electric properties (e.g., insulation resistance is about ten times higher than ordinary). Irradiated crosslinked PVC shows many interesting properties and can also be applied for many other uses. (auth)

25906 REACTIONS OF HALOGENOALIPHATIC ACIDS WITH FREE RADICALS IN AQUEOUS SOLUTION. PART II. REACTIONS WITH ALIPHATIC FREE RADICALS. **Anbar, M. (Weizmann Inst. of Science, Rehovoth, Israel); Neta, P. J. Chem. Soc. (A), No. 5, 837-41(1967).**

Dehalogenation of halogenoaliphatic compounds by aliphatic free radicals was investigated. The reactivity of the radicals studied followed the sequence $BrCH_2 \cdot CH \cdot OH \simeq ClCH_2{-}CH \cdot OH > (CH_3)_2C \cdot OH > CH_3 \cdot CH \cdot OH > CH_2 \cdot OH \geq CBr_2 \cdot CO_2H > CH_3 \cdot CBr \cdot CO_2H > BrCH \cdot CO_2H \gg CH_3 \cdot CH \cdot CO_2H \simeq CH_2 \cdot CO_2H$. The last two radicals did not induce any dehalogenation. The reactivity of the substrates toward the radicals increased in the order $ClCH_2 \cdot CH_2 \cdot OH < ClCH_2 \cdot CO_2H < BrCH_2 \cdot CO_2H < CBr_3 \cdot CO_2H$. The results indicate a charge-transfer mechanism in these reactions rather than halogen abstraction. Irradiations were performed in a ^{60}Co gamma source at a dose rate of 4×10^{17} eV/g/min. (auth)

25907 REACTIONS OF HALOGENOALIPHATIC ACIDS WITH FREE RADICALS IN AQUEOUS SOLUTION. PART III. REACTIONS WITH INORGANIC FREE RADICALS. **Anbar, M. (Weizmann Inst. of Science, Rehovoth, Israel); Neta, P. J. Chem. Soc. (A), No. 5, 841-2(1967).**

The ions CO_2^-, Cd^+, Ni^+, Co^+, Al^{2+}, Zn^+, and Mn^+ were found to induce dehalogenation of $ClCH_2 \cdot CO_2^-$, $ClCH_2 \cdot CH_2 \cdot OH$, and $BrCH_2 \cdot CO_2^-$, the order of reactivity being $RCl < RBr$. On the other hand, N_2O^-, O_2^-, NO_3^{2-}, and Cu^+, did not induce dehalogenation. Whereas CO_2^- seemed to react by a charge-transfer mechanism, the metal ions at their lower state of oxidation seemed to react by an inner-sphere mechanism involving halogen atom transfer from the halogenoaliphatic compound. Irradiations were performed in a ^{60}Co gamma source at a dose rate of 4×10^{17} eV/g/min. (auth)

25908 SEPARATION AND PREPARATION OF ^{238}Pu FROM NEUTRON IRRADIATED ^{237}Np TARGET. APPLICATION OF TIOA–HCl SYSTEM SOLVENT EXTRACTION METHOD. **Sakanoue, Masanobu; Osawa, Masumi; Miyaji, Nobuyoshi (Kanazawa Univ., Japan). Nippon Genshiryoku Gakkaishi, 9: 138-45(Mar. 1967). (In Japanese).**

In order to study the abundance and distribution of plutonium in natural samples, tracers are required to determine the recovery of the element after the many stages of separation and preparation applied to the counting source. For this purpose α-emitting ^{238}Pu was chosen; it was separated into carrier-free state from thermal-neutron-irradiated ^{237}Np target by solvent extraction using triisoöctylamine. In order to ascertain complete separation of the plutonium from neptunium and protactinium, the oxidation and reduction of plutonium in hydrochloric acid solutions and the extraction behavior of plutonium at different oxidation states were studied. Results of α spectrometry on the ^{238}Pu thus obtained proved it to be pure enough to be used for determination of ^{239}Pu. (auth)

25909 THERMAL ANNEALING OF ^{82}Br IN NEUTRON-IRRADIATED p-DIBROMOBENZENE. **Narbutt, J.; Dancewicz, D.; Halpern, A. (Inst. for Nuclear Research, Warsaw). Radiochim. Acta, 7: 55-7(Mar. 1967).**

The distribution of ^{82}Br in neutron-irradiated p-dibromobenzene and the subsequent isothermal annealing were studied. A chromatogram of the sample showed five peaks: the position of the first peak corresponded to inorganic bromine and an unidentified organic product, the second to o-dibromobenzene, the third to m-dibromobenzene and as-tribromobenzene, the fourth to bromobenzene, and the fifth to p-dibromobenzene. Thermal annealing caused an increase in the yield of the parent form at the expense of the species eluted in the first peak, while the yields of m-dibromobenzene + as-tribromobenzene and of bromobenzene remained constant. The tentative model postulated is summarized as follows: the isothermal heating of neutron-irradiated p-dibromobenzene crystals caused the original chemical form to be rebuilt via a two-step process in which the rapid formation of a ^{82}Br-labeled unidentified organic species (fast stage of the process) is followed by a comparatively slow isotopic exchange between the latter and surrounding molecules in the crystal (slow stage of the process). Both the rate and the extent of this exchange depended on the temperature. (D.H.M.)

25910 ELECTRON SPIN RESONANCE OBSERVATIONS ON TRAPPED ELECTRONS AND FREE RADICALS FORMED IN OLEFINS AT 77°K BY γ IRRADIATION. **Smith, D. R.; Okenka, F.; Pieroni, J. J. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Chem., 45: 833-7(Apr. 15, 1967). (AECL-2864).**

Electron spin resonance (ESR) methods were used to search for the γ-induced formation of trapped electrons and free radicals in 13 straight-chain and branched-chain terminal olefins at 77°K. When ESR spectra were observed they were used to identify the species present. Changes induced by subsequent exposure to visible and ultraviolet (uv) light were investigated. Trapped electrons were observed in three olefins that exist as glasses at 77°K, hexene-1, hexene-2, and 2-methylbutene-1, but were not detected in two other glassy olefins, possibly because of rapid annealing. No trapped electrons were found in polycrystalline olefins at 77°K. The possibility that CO_2^- ions were misinterpreted as trapped electrons in these and other systems is discussed and eliminated. The formation and behavior of free radicals and trapped electrons in irradiated 2-methylbutene-1 are analogous to those previously reported for 2-methylpentene-1 under similar conditions. These observations support the hypothesis that in these two systems ions produced initially isomerize rapidly, leading to the formation of the free radicals detected by ESR. The results of a subsidiary experiment suggest that hydrogen abstraction from the matrix is induced by uv photolysis of the radicals present in 2-methylpentene-1. (auth)

25911 THE PRODUCTION OF ^{39}Ar USING REACTOR NEUTRONS. **Schmeling, Per (Kernforschungszentrum, Karlsruhe, Ger.). Radiochim. Acta, 7: 58(Mar. 1967).**

The use of the $^{39}K(n,p)^{39}Ar$ reaction to produce ^{39}Ar of high specific activity was investigated. Potassium chloride can be used for the production of ^{39}Ar, but high doses produce ^{35}S and small amounts of ^{36}Cl. The production of ^{36}Cl and other contaminants by (n,γ) reaction can be avoided by irradiation in cadmium. Potassium chloride was irradiated in the thermal column of FR2 reactor to an integrated flux of 3.7×10^{17} cm^{-2}; but no ^{39}Ar could be found. It was estimated that the cross section for thermal neutrons was less than 0.05 mb. The effective cross sections for the reaction $^{39}K(n,p)^{39}Ar$ for the FR2, BER, and BR2 reactors are given. (D.H.M.)

25912 SEPARATION OF PURE ^{223}Fr FROM ^{227}Ac ON A SEPARATION COLUMN. **Lieser, K. H.; Kluge, E. (Technische Hochschule, Darmstadt, Ger.). Radiochim. Acta, 7: 3-9 (Mar. 1967). (In German).**

Pure ^{223}Fr can be separated from all the other decay products of ^{227}Ac in one operation. The ^{227}Ac is fixed on a Dowex-50 column. This column is followed by a second column containing silica gel covered with $BaSO_4$. The elution is carried out with a chromate containing solution of ammoniumchloride. $BaCrO_4$ on silica gel can also be used instead of $BaSO_4$ on silica gel. This separation method yields about 90% of the ^{223}Fr; the radiochemical purity is better than 99.9%. (auth)

25913 NEW ISOTOPES ^{141}Sm AND ^{140}Sm. **Herrmann, E.; Pfrepper, G.; Christov, D. (Joint Inst. for Nuclear Research, Dubna, USSR). Radiochim. Acta, 7: 10-12(Mar. 1967). (In German).**

The new isotopes of samarium ^{141}Sm and ^{140}Sm with the half-lives of (22.5 ± 1.4) and (13.7 ± 0.8) min, respectively, were obtained by bombarding metallic erbium with 660-MeV protons. Their identification succeeded by repeatedly chemical separations of their radioactive daughters. Chemical separation takes place both by extraction chromatographic method with bis(2-ethylhexyl)phosphate silica gel columns and by Szilard-Chalmers-reaction on the samarium phthalocyanin complexes. (auth)

25914 THE HOT ^{14}C DISTRIBUTION IN MOLECULES OF QUINOLINE AND ACRIDINE. **Forys, Mieczyslaw (Warsaw Univ.). Radiochim. Acta, 7: 13-15(Mar. 1967).**

The hot ^{14}C distribution in molecules of irradiated acridine and quinoline were investigated. It was shown that a correlation between carbon substitution yields and the reactivity of positions in the molecule in typical hydrogen substitution reactions exists. (auth)

25915 CHEMICAL FORMS OF ^{37}S PRODUCED BY THE REACTION $^{37}Cl(n,p)^{37}S$ IN AQUEOUS SOLUTIONS OF LITHIUM CHLORIDE, SODIUM CHLORATE, AND SODIUM PERCHLORATE. **Meyer, J. P.; Adloff, J. P. (Centre de Recherches Nucleaires, Strasbourg). Radiochim. Acta, 7: 15-19(Mar. 1967). (In French).**

The chemical forms of ^{37}S produced by $^{37}Cl(n,p)^{37}S$ reaction in aqueous solutions were determined. Irradiation of lithium chloride led to the following distribution of the sulfur activity: SO_4^{2-} (64%), SO_3^{2-} (6%), $S_2O_3^{2-}$ (8%), and S^{2-} (15%). In the case of a sodium chlorate solution, ^{37}S appeared as SO_4^{2-} (89%) and S^{2-} (10%), and the perchlorate led to SO_4^{2-} (75%), SO_3^{2-} (8%), and S^{2-} (13%). Reaction schemes are proposed. (auth)

25916 REACTIONS OF HALOGENOALIPHATIC ACIDS WITH FREE RADICALS IN AQUEOUS SOLUTION. PART I. REACTIONS WITH HYDROGEN ATOMS. Anbar, M. (Weizmann Inst. of Science, Rehovoth, Israel); Neta, P. J. Chem. Soc. (A), No. 5, 834-7(1967).

Rates of reactions of halogenoaliphatic compounds with hydrogen atoms and hydroxyl radicals were measured. The reactions with hydrogen atoms involved both hydrogen abstraction and dehalogenation. The dehalogenation by hydrogen atoms was shown to be an atom transfer rather than a charge-transfer process. Irradiations were performed in a ^{60}Co gamma source at a dose rate of 4 × 10^{17} eV/g/min. (auth)

25917 INFLUENCE OF ETHYLENE ON THE RADIOLYTIC OXIDATION OF FERROUS SULPHATE. Basson, R. A.; du Plessis, T. A. (Atomic Energy Board, Pretoria). J. Chem. Soc. (A), No. 5, 778-81(1967).

Addition of ethylene to oxygenated aqueous ferrous sulphate solutions increased the radiolytic yield of ferric ion. Formaldehyde and acetaldehyde were also found as radiolysis products. Ferric yields were linear with dose between 2 × 10^{17} and 10^{18} eV/ml, but G(HCHO) decreased and G($CH_3 \cdot CHO$) increased with increasing dose. At lower doses very high initial G-values were obtained for all three products. The reasons for these high values are not clear, but the yields at higher doses are adequately accounted for by the suggested mechanism. (auth)

25918 VAPOR-PHASE RADIATION CHEMISTRY STUDIED BY ELECTRON SPIN RESONANCE SPECTROSCOPY. Smith, D. R.; Tole, J. C. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Chem., 45: 779-83(Apr. 15, 1967). (AECL-2860).

The techniques and some preliminary results of an indirect method of studying vapor-phase radiolysis by electron spin resonance (ESR) spectroscopy are reported. After traversing a beam of 40 keV Ar^+ ions, a stream of vapor is condensed on a cold finger at 77°K. Free radicals formed by ion bombardment in the vapor phase become trapped in the solid deposit and are detected by ESR. Various vapors such as cyclopentane, cyclohexane, benzene, and ethanol were bombarded at room temperature. The results correlate with conventional radiation chemical data. For example, benzene forms $C_6H_7^{\cdot}$ (and probably $C_6H_5^{\cdot}$) radicals. These may be the intermediates which lead to polymer formation when benzene vapor is irradiated. The potential value of the experiment to vapor phase radiation chemistry is discussed. (auth)

25919 SPECTROMETRIC STUDIES OF γ-IRRADIATED SULFURIC ACID GLASSES. Russell, J. C. (Univ. of Leeds, Eng.). Can. J. Chem., 45: 839-45(Apr. 15, 1967).

Gamma-irradiated sulfuric acid glasses were studied at low temperatures by optical spectrophotometry and electron spin resonance (ESR) spectrometry. The effects of nitrous oxide and ferrous ion on the spectra were observed. Optical absorptions were found with maxima at 22,000 and 32,000 cm^{-1} in the pure glass and at 41,000 cm^{-1} in the presence of ferrous ion, as well as two ESR absorptions. These were a poorly resolved triplet and a narrow singlet. The spectra, and the changes observed on warming, suggested the presence of three species in the glass: a free radical similar to the radical ion SO_4^-, a ferric ion precursor, and a third unidentified species formed with a small yield. (auth)

25920 ELECTRON SPIN RESONANCE STUDY OF CYCLOHEXADIENYL RADICALS FORMED BY γ IRRADIATION OF SOLID SUBSTITUTED BENZENES. Campbell, D.; Turner, D. T. (Research Triangle Inst., Research Triangle Park, N. C.). Can. J. Chem., 45: 881-4(Apr. 15, 1967).

Samples of solid substituted benzenes in quartz tubes were irradiated at room temperature to a total dose of 10 to 20 MRAD. After irradiation the quartz was annealed and first and second derivatives of the absorption curve were recorded at room temperature. The compounds that gave spectra judged to contain a contribution from cyclohexadienyl-type radicals are listed. The contribution from this radical was predominant in the spectra of benzoic acid, biphenyl, resorcinol, m-hydroxybenzoic acid, and isophthalic acid, but in most cases its presence could only be inferred from structure in the wings of the spectra. Monosubstituted benzenes all gave triplet secondary structure, which indicated ortho and (or) para addition of hydrogen atoms. Further evidence for ortho and (or) para additions was provided by the spectra of 1,3-disubstituted benzenes, which gave 1 : 1 doublet splitting of the main $-CH_2-$ triplet. 1,2-Disubstituted and 1,4-disubstituted benzenes gave triplet secondary splitting. When the compounds in which cyclohexadienyl-type radicals were found preferentially were γ-irradiated at −196°C, the ESR spectra showed that in each case the number of cyclohexadienyl-type radicals formed at −196°C was substantially less than at room temperature. Single crystals of resorcinol and benzoic acid were irradiated at room temperature and their ESR spectra examined. A list is also given of substituted benzenes that did not give cyclohexadienyl-type spectra. (D.H.M.)

25921 EARLY FOX TALBOT PHOTOGRAPHS AND RESTORATION IN NEUTRON IRRADIATION. Ostroff, Eugene (Smithsonian Institution, Washington, D. C.). J. Photogr. Sci., 13: 213-27(1965).

A non-destructive neutron activation method was devised to obtain satisfactory prints of badly faded photographs taken by an inventor of the photographic process over 100 yr ago. By irradiating the picture with neutrons some of the image silver was converted into its isotopic forms. Through autoradiographic procedures a restored facsimile was obtained. For this technique to be successful, the faded prints must still contain the image silver even though the image itself may no longer be completely visible. The print must be relatively free of non-image silver and silver halides. Neutron irradiation converts a portion of the silver to ^{108}Ag and ^{110}Ag. ^{108}Ag decays by giving off high-energy β rays and low-energy γ rays, and it has a half-life of 2.3 minutes. ^{110}Ag has 2 radioactive forms, one with a half-life of 253 days and one with a half-life of 24.2 sec. The constituents of sodium thiosulfate have relatively longer half-lives and do not mask the activity of the silver. If present, halogens (bromine, iodine, and chlorine) prevent successful results. The possible effects of neutron irradiation on the characteristics of the photographs, i.e., that they might darken, undergo additional fading, experience color change, increase in brittleness, or experience damage from the heat within the flux, were investigated with modern gelatin silver halide prints. None of these effects was noted. Exposure of the prints for several seconds to a neutron flux of 5 × 10^{12} neutrons/cm^2 sec gave optimal results. Definition was improved and the image density and contrast were increased in the autoradiographs. (BBB)

25922 STUDIES ON X-AGENT. LI. EFFECTS OF X-AGENT ON ALKALINE THYMOL-BLUE SOLUTIONS. Moriyama, Hideo (Shonan Hygiene Inst., Kamakura, Japan). Yokohama Med. Bull., 17: 201-8(Dec. 1966).

The ability of X agent to discolor aqueous alkaline solutions of Thymol Blue was studied. The effect of X agent on dye discoloration varied greatly with both the place and time where and when the effect was examined. When examined under bright illumination, the discoloration of the dye solution covered with aluminum foil was less than that of uncovered solutions, suggesting that the soft agent that failed to penetrate the foil promoted the discoloration. However, in a box with thick metallic walls, the discoloration tended to occur more strongly under bright illumination and in a cardboard box the discoloration was promoted in some cases by covering with aluminum foil. Such contradictory phenomena were explained by postulating antagonistic actions of X agent and also its degree of hardness. It was possible to demonstrate the effect of water on dye discoloration. This effect was attributed to the secondary X agent produced by the water. The thymol blue solution was markedly affected in a metal box as well as in a dark room during periods when an alkaline neutral-red solution was not affected under the same conditions, in spite of the fact that both were alkaline solutions of dyes. (BBB)

25923 GAMMA-RADIATION-INDUCED POLYMERIZATION OF ETHYLENE. Kukacka, L. E.; Colombo, P.; Steinberg, M. (Brookhaven National Lab., Upton, N. Y.). J. Polym. Sci. Pt. C, No. 16, 579-89(1967).

From Meeting on Macromolecular Chemistry, Prague, Aug. 30–Sept. 4, 1965.

Kinetics and product characteristics of the ^{60}Co gamma-induced polymerization of ethylene were studied as a function of pressure, radiation intensity, and temperature. Experiments were carried out under conditions that ranged in pressure from 170 to 1360 atm, in temperature from 20 to 200°C, and in radiation intensity from 5.8 × 10^4 to 8.5 × 10^5 RAD/hr. Activation energies of 0.2 to 14.5 kcal/mole were determined for the temperature ranges 20 to 100°C and 120 to 200°C, respectively. Empirical relationships for the rate of polymerization and the radiation yield for the range of pressure and radiation intensity studied and for temperatures between 20 and 100°C are as follows: $Q = (1.39 \pm 0.37) \times 10^{-8} e^{-200/RT} p^{2.7} I^{0.5}$; $G = (3.50 \pm 0.95) c^{-200/RT} p^{2.5} I^{-0.5}$, where Q = polymerization rate, g/l-hr., G = radiation yield, molecules/100 eV, P = pressure, atm, and I = radiation intensity, RAD/hr. The 0.5 power dependence of the intensity on rate indicates a free radical mechanism. The polymers produced over the entire range of conditions were found to be completely soluble. Densities ranged from 0.95 g/cc for material formed at 20°C to 0.91 g/cc for material formed at 120°C. The weight-average molecular weight decreased from 1.5×10^6 to 4.7×10^4 over the same temperature range. The molecular weight was found to increase with pressure and with decreasing radiation intensity. All polymers formed at temperatures below 120°C had a melt index of <0.06 g/10 min. (auth)

25924 PULSE RADIOLYSIS OF WATER AND AQUEOUS SOLUTIONS. Pikaev, A. K. Bloomington, Ind., Indiana University Press, 1967. 309p. $10.00.

Translation of Impulsnyi Radioliz Vody i Vodnykh Rastvorov by Scripta Technica, Inc.

The following topics are covered: (1) basic concepts of radiation chemistry of water and aqueous solutions, (2) sources of pulses of ionizing radiation dosimetry, (3) radiolysis of water and aqueous solutions at high doses of absorbed radiation, (4) identification of short-lived products and determination of their reactions in aqueous solutions using pulse radiolysis, (5) study of kinetics of radiochemical reactions in aqueous solutions using radiation pulses, (6) rate of radioinduced reactions in aqueous solutions, and (7) possible applications of pulse-type radiation to problems of radiation chemistry. (B.L.M.)

25925 PRODUCTION OF HYDRAZINE. Johnston, W. H.; Lampe, F. W. (to U. S. Atomic Energy Commission). U. S. Patent 3,322,660. May 30, 1967.

A process for the manufacture of hydrazine comprises irradiating a mixture of ammonia and a rare gas with an ionizing radiation of sufficient energy to ionize the rare gas. The rare gas must have an ionic recombination energy of less than 15 eV. (AEC)

25926 PROCESS FOR PRODUCING HIGH MOLECULAR WEIGHT POLYOXYMETHYLENE. (to Asahi Kasei Kogyo Kabushiki Kaisha). British Patent 1,067,358. May 3, 1967. Priority date Dec. 28, 1963, Japan.

A process for producing high-molecular-weight polyoxymethylene of high purity consists of subjecting low-molecular-weight polyoxymethylene or paraformaldehyde having a high water content to ionizing radiation or ultraviolet radiation in a closed system to produce polyoxymethylene of a higher molecular weight and usually a lower water content. This higher-molecular-weight polyoxymethylene is then subjected to pyrolysis to yield a formaldehyde of very high purity and very low moisture content, which is then polymerized by a conventional method to yield the polyoxymethylene having improved thermal stability and good molding properties. (B.L.M.)

25927 ELECTRIC CABLES INSULATED WITH RADIATION CROSS-LINKED POLYVINYL CHLORIDE. White, Francis Thomas; Mann, Ronald (to Associated Electrical Industries Ltd.). British Patent 1,066,610. Apr. 26, 1967. Filed Mar. 25, 1965.

A process for improving the hardness of poly(vinyl chloride) in the temperature range from 100 to 160°C for use as electric cable insulation comprises coating an electrical conductor with a composition made up of vinyl chloride and a polyfunctional unsaturated ester and subjecting this to high-energy electron radiation to accomplish polymeric crosslinking. The radiation dose should be in the range of 0.5 to 20 Mrads. (B.L.M.)

Radiochemistry

Refer also to abstract 25914.

25928 (UJV-1633) RADIOCHEMICAL METHODS OF DETERMINATION OF NUCLEAR FUEL BURN-UP. Bezdek, M.; Krtil, J. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). Jan. 1967. 33p. Dep.

Methods for determination of the burnup of the nuclear fuel are surveyed. The influence of various factors on the accuracy of burnup determination is discussed as well as some formulas for burnup calculations. Maximum attention was centered on destructive methods of burnup determination, especially radiochemical methods for the preparation of radiochemicaly pure standards of various radioisotopes (for example ^{137}Cs, ^{144}Ce, etc.). The appliance of published radiochemical methods for burnup analysis is discussed. (auth)

25929 INVESTIGATIONS OF THE DISTRIBUTION OF RADIUM BETWEEN THE SOLID AND THE LIQUID PHASE IN THE PROCESS OF SYNCHRONIZED PRECIPITATION. PART II. Przytycka, Roza (Inst. of Nuclear Research, Warsaw). Nukleonika, 12: 205-10(1967).

The behavior of three distribution coefficients: D, λ, and %Ra/%Ba, expressing the distribution of trace elements in carrier sediments is discussed. It was found that coprecipitation of radium by means of the synchronized precipitation method does not obey the homogeneous distribution law but rather the logarithmic distribution law. The results showed that coprecipitation proceeds according to a much more complicated scheme than that of Doerner and Hoskins (J. Am. Chem. Soc., 47: 662(1925)). Radium is very intensively concentrated in the center of the crystal. (P.C.H.)

25930 INVESTIGATIONS ON THE DISTRIBUTION OF RADIUM BETWEEN THE SOLID AND THE LIQUID PHASE IN THE PROCESS OF SYNCHRONIZED PRECIPITATION. PART I. Przytycka, Roza; Adamski, Tadeusz (Inst. of Nuclear Research, Warsaw). Nukleonika, 12: 193-204(1967).

The synchronized precipitation technique was used to investigate the distribution of radium in mixed crystals of barium radium chromate. The influence of three parameters: the time of precipitation, pH of solution, and the quantity of precipitated barium on the logarithmic distribution coefficient λ was examined. The conditions leading to high enrichment of barium chromate in radium were established. (auth)

25931 TRACER STUDY OF THE REACTIONS PROMOTED BY THE DECAY OF A TRITIUM ATOM CONTAINED IN THE MOLECULE OF ETHANE. Aliprandi, Bianca; Cacace, Fulvio; Guarino, Angelo (Univ., Rome). J. Chem. Soc. (B), No. 5, 519-22(1967).

The chemical fate of a tritiated ethane molecule following the decay of the radioactive atom was studied employing a tracer technique; [1,2-${}^3H_2$]ethane was allowed to decay in gaseous systems at atmospheric pressure. From analysis of the tritiated decay products a detailed picture of the chemical processes following the nuclear transition was obtained. The results are consistent with the hypothesis that decay-induced fragmentation of the ethane molecule is largely independent of pressure. The labelled ethyl ions formed in about 80% of the β-transitions undergo a hydride-ion transfer reaction with the inactive ethane molecules, while the labelled products other than ethane originate from the fragmentation processes that take place in about 20% of the decay events, and from the reactions of the fragment ions. The agreement between experimental yields of the labelled decay products and those expected from the current knowledge on ion–molecule reactions in the systems investigated confirmed that the decay of suitably labelled molecules can afford a useful tool for the study of the ion–molecule reactions in systems at atmospheric pressure. (auth)

25932 PREPARATION OF THIN SOURCES EMPLOYING SURFACE-ACTIVE COMPOUNDS. Kutsentov, L. M.; Fleisher, V. G. (Ioffe Inst. of Physics and Tech., Leningrad). Izv. Akad. Nauk SSSR, Ser. Fiz., 30: 455-8(Mar. 1966). (In Russian).

Chemical methods are described for the preparation of α- and β-radiation sources of minimal thickness. The method of direct introduction of cations from an aqueous solution was used for preparing a monomolecular ^{203}Hg source, suitable for detecting electrons with an energy above a few electron volts. Using an HgCl preparation with specific activity (a) = 0.5 μC/mg, a two-layer source with an activity of 0.042 μC/cm² was prepared. A relatively simple procedure for synthesis of cetyl phosphate, which was used for preparing a monomolecular ^{32}P source in utilizing phosphoric acid with high specific activity, is also described. (P.C.H.)

25933 AN ISOTOPE EFFECT IN THE COLLECTION OF RECOILED PRODUCTS IN C_2H_5Br, $C_2H_4Br_2$, AND CH_2Br_2. Lal, A. (Banaras Hindu Univ., Varanasi, India). Indian J. Phys., 41: 39-47(Jan. 1967).

Collection of recoil products of ethyl bromide ethylene dibromide, and methylene dibromide and the associated isotope effect were studied. The effect was observed on both the anode and the cathode using a Ra + Be source of 300 mCi. A possible explanation for the higher enrichment on the anode and for the isotope effect was attempted on the basis of "Auger Electron Hypothesis" suggested by Geissler and Willard. (auth)

25934 PREPARATION OF FILMS AND SOURCES FOR 4 π COUNTING. Konstantinov, A. A.; Sazonova, T. E. (Mendeleev All-Union Scientific-Research Inst., Leningrad). Vienna, International Atomic Energy Agency, 1966, Preprint No. SM-79/71, 4p. (In Russian). (CONF-661012-47). DTIE.

From IAEA Symposium on the Standardization of Radionuclides, Vienna.

Use of the electron-capture nuclide ^{54}Mn(^{54}Cr) for determination of the uniformity in plotting the activity of precipitates of processed insulin sources of small cross sectional area seems a very sensitive and effective method. (tr-auth)

Separation Processes

Refer also to abstracts 25908, 25912, 25913, 26750, and 26877.

25935 (ANL-7225) CHEMICAL ENGINEERING DIVISION SEMIANNUAL REPORT, JANUARY-JUNE 1966. (Argonne National Lab., Ill.). Nov. 1966. Contract W-31-109-eng-38. 235p. Dep. CFSTI.

Research progress is reported under the following headings: compact pyrochemical processes, fluidization and volatility processes, materials chemistry and thermodynamics, chemical and energy transfer problems in reactor safety, energy conversion, nuclear constants, and analytical research and development. (M.C.G.)

25936 (ISO-595) PROPOSED REDOX DISSOLUTION AND HEAD END FLOWSHEETS FOR PWR-1 (SHIPPINGPORT) BLANKET FUEL ELEMENTS. Davis, Daniel F. (Isochem Inc., Richland, Wash.). Nov. 22, 1966. Contract AT(45-1)-1851. 14p. Dep. CFSTI.

The flowsheets for recovery of Am and Cm from PWR-1 blanket fuel elements were written for a 144-subassembly charge, 5900 pounds UO_2, and 2200 pounds Zircaloy-2. This will be shipped in 12 standard slug buckets in four standard cask cars of the type normally used for DUN reactor service. The cladding of the fuel elements is penetrated with Zirflex solution. A deep water-flush is used to remove fluorides and then the exposed UO_2 core is leached out with nitric acid. A second Zirflex dissolution on the same charge is followed by a second water flush and nitric acid leach of UO_2 heel. Two Zirflex dissolutions then dissolve the Zircaloy-2 remaining. Excess nitric acid is boiled off dissolver solution. (auth)

25937 (K-L-1780(Pt.19)) ORGDP FUEL REPROCESSING STUDIES. Progress Report for Period Ending February 28, 1967. Smiley, S. H. (Oak Ridge Gaseous Diffusion Plant, Tenn.). Apr. 3, 1967. Contract W-7405-eng-26. 32p. Dep. CFSTI.

Studies were continued on the oxidation step in the semiworks reactor facility. All runs were made using EGCR fuel. Other developments included: performance testing of filters in volatility process corrosive atmospheres; fluidization tests for possible application in separating U_3O_8 fines from the bed of the main reactor by elutriation; evaluation of connector bolting; and operation of the ORGDP peripheral compressor in fluorine recycle service. (P.C.H.)

25938 DECONTAMINATION OF RADIOACTIVE WATER BY COPRECIPITATION WITH TITANIUM HYDROXIDE. Komatsu, Tsuyoshi (Hokkaido Univ., Sapporo). J. Water Pollut. Contr. Federation, 39: 123-7(Jan. 1967).

Removal of radiostrontium and mixed fission products from water by coprecipitation with titanium hydroxide was studied. Little radiostrontium coprecipitated on ferric hydroxide or aluminum hydroxide from neutral solution. Titanium hydroxide removed about 5 times the amount of radiostrontium that could be removed by coprecipitation with other hydroxides under the same conditions. About 30% of the mixed fission products was removed from neutral solution (1 mμCi/ml) by coprecipitation with 1 m$\underline{N}$ ferric hydroxide or aluminum hydroxide, while about 70% was removed with titanium hydroxide. With this hydroxide, most of the residual radioactivity would be due to $^{137}Cs-^{137m}Ba$, because radioactive lanthanide nuclides such as $^{144}Ce-^{144}Pr$ and ^{147}Pm are removed easily by the coprecipitation with metal hydroxide precipitates. The costs for precipitation with titanium hydroxide are about \$6/lb-equivalent (1.33¢/g-equivalent) whereas those for alum are \$2.90/lb-equivalent (0.66¢/g-equivalent). Thus, for a 5-fold increase in removal capacity, there is only a 2-fold increase in cost. Titanium hydroxide is preferable to the traditional metal hydroxides for the removal of radiostrontium. (BBB)

25939 SOLIDIFICATION OF HIGH-LEVEL RADIOACTIVE WASTES. PART I. SELECTION OF THE RAW MATERIALS. Saidl, J.; Ralkova, J. (Inst. for Nuclear Research, Czechoslovak Academy of Sciences, Rez). Kernenergie, 10: 92-5 (Mar. 1967). (In German).

Methods were developed enabling the fixation of high-level radioactivity in solid and chemically resistant materials. Various silicate compositions such as glasses or glass-forming materials and rocks show the best properties for this purpose. Melted basalts warrant the safe retention of high-level radioactive wastes. (auth)

25940 TREATMENT OF URANIUM MILL EFFLUENTS. Kortus, Josef (Inst. for Design of Chemical Engineering Equipment, Prague); Plechaty, Ladislav; Klicka, Vladimir. Jad. Energ., 13: 7-12(Jan. 1967). (In Czech).

The problem of radioactive pollution from uranium mill effluents is considered. Methods of decontamination for radium, uranium, and polonium are briefly described. Some detailed information about evaporation equipment for treatment of uranium mill effluents is given. (auth)

25941 SEPARATION OF RARE EARTH FISSION PRODUCTS BY LACTIC ACID-ETHYLENEDIAMINETETRAACETIC ACID ELUTION. Bruecher, E.; Szarvas, P. (Univ., Debrecen, Hungary). Acta Chim. Acad. Sci. Hung., 52: 31-5(1967).

A study was made of the effect of lactate ions on the cation-exchange separation of rare earth elements by eluting with ethylenediaminetetraacetic acid (EDTA). The desorption rate of rare earth ions from the resin phase is considerably higher if in addition to EDTA the eluant also contains lactic acid. The separation factors obtained at 20°C using a solution of EDTA and lactic acid as the eluant are much higher than those obtained in the NH_4-α-hydroxyisobutyrate elutions at 90°C. The widths of elution peaks are about the same as with the use of NH_4-lactate. A good separation can be achieved for fission-product rare earths on a 2 mm × 7 mm Dowex 50 × 8 resin column using a solution of 0.002$\underline{M}$ for EDTA and 0.4$\underline{M}$ for lactic acid as the eluant, raising the pH from 3.0 to 3.5 during elution. (auth)

25942 URANIUM FROM SEAWATER. Sani, A. R. (Atomic Energy Centre, Lahore). Nucleus Lahore, 3: 102-4(Oct.-Dec. 1966).

Work done on the use of seawater as a source of uranium is reviewed. Two of the major obstacles are: the uranium is in a strongly complexed form at an extreme dilution in the presence of relatively high concentration of other ions, and any extractant that could be used must be brought into contact with a very large volume of water and must function efficiently at the pH of the seawater. The use of various organic and inorganic absorbants is discussed, specifically titanium hydroxide. The ion-flotation method is also considered. The use of activated charcoal for the recovery of uranium from seawater is currently being investigated. (D.H.M.)

25943 AN IMPROVED METHOD FOR RUTHENIUM ANALYSIS. SEPARATION FROM URANIUM BY PRESSURE PRECIPITATION WITH H_2S. Rao, M. N. (Univ. of Arkansas, Fayetteville). Z. Anal. Chem., 227: 326-30(1967). (ORO-3235-9).

Pressure precipitation of ruthenium with hydrogen sulfide is recommended for its separation from uranium. The separations from uranium solutions and from pitchblende are described as examples. (auth)

25944 THIN-LAYER CHROMATOGRAPHY OF INORGANIC IONS. A SELECTIVE SEPARATION OF URANIUM. Lesigang-Buchtela, Margrit; Buchtela, Karl (Univ., Vienna). Mikrochim. Acta, 3: 570-4(1967). (In German).

A thin-layer chromatographic separation of uranium from other cations is described. The supporting material is silica gel or cellulose, the mobile phase is a mixture of hexone, tributyl phosphate, and nitric acid. Uranium migrates with the "second" solvent front. Fifty-five other cations investigated remain at the starting point or else have very low R_f-values and can be separated from uranium. (auth)

25945 SEPARATION OF CALIFORNIUM FROM CURIUM AND BERKELIUM FROM CERIUM BY EXTRACTION CHROMATOGRAPHY. Moore, Fletcher L.; Jurriaanse, Aart (Oak Ridge National Lab., Tenn.). Anal. Chem., 39: 733-6(June 1967). (ORNL-P-2844).

An extremely simple method is described for the separation of californium(III) from curium(III) and berkelium(III) from cerium(III). The new method is based on extraction chromatography utilizing small Teflon columns containing di(2-ethylhexyl)-orthophosphoric acid as the stationary phase. Excellent separations were achieved with dilute nitric acid eluents. Among the significant advantages of the system are room temperature operation, use of nonchloride media, relatively high flow rates, and applicability for glove box or hot cell work. Several useful analytical and process applications are discussed. (auth)

25946 PRODUCTION OF RADIOACTIVE STANDARDS FOR PAPERCHROMATOGRAPHICAL INVESTIGATIONS. I. SEPARATION OF ^{140}Ba AND ^{140}La BY MEANS OF THE ANNULAR FURNACE METHOD. Sorantin, H. (Technische Hochschule, Vienna). Atompraxis, 12: 609-12(Dec. 1966). (In German).

The annular furnace method was used for the separation of the nuclide pair $^{140}Ba-^{140}La$ on different kinds of paper and in acid or alkaline media. After testing precipitation, extraction, ionic exchange and chromatographic procedures, on resinconditioned papers fastest separation was achieved by 0.1 to 0.2 $\underline{N}$ NH_4CNS solutions. ^{140}La remained in the center of the paper disc, while ^{140}Ba was concentrated in the outer ring area. Both zones were punched out and taken as standards for comparative measurements. Reversed positions—^{140}Ba on the inner spot and ^{140}La at the periphery of the annular ring—were possible by precipitation of $^{140}BaSO_4$ or TTA extraction. Quantitative separation was proved by the precipitation of ^{140}La. (auth)

25947 ION EXCHANGE AND EXTRACTION METHODS FOR SEPARATION OF URANIUM. Korkisch, J. (Univ., Vienna). Mikrochim. Acta, 3: 401-16(1967).

The most important ion exchange and extraction methods for the separation of uranium are reviewed. The most important anion exchange methods, frequently employed for the separation of uranium, are those in which the uranium is absorbed either as anionic sulfato- or chloro complex on strongly basic resins, such as Dowex 1. The methods particularly suited for analytical purposes are those based on the separation of uranium in hydrochloric acid–mixed water–organic systems. Likewise, in the cation exchange methods, a high selectivity of the separations is attained in mixed water–organic media, especially in a nitric acid–tetrahydrofuran solution. The extraction of the uranium from nitric acid solutions by means of phosphorus organic compounds is discussed in more detail in the discussion of the extraction methods. (168 references) (auth)

25948 DETERMINATION OF ^{210}Pb BY INTERNAL ELECTROLYSIS OF ITS ^{210}Bi DAUGHTER. Jaworowski, Zbigniew (Inst. of Nuclear Research, Warsaw); Bilkiewicz, Jan. Nukleonika, 12: 225-9(1967).

A method for the separation of minute amounts of ^{210}Bi by electrolytic deposition on platinum is described. The main advantages of the method are simplicity of operation and elimination of self-absorption problems in the counting sample. Carrier-free ^{210}Bi can also be prepared in this way. A modified method for the determination of ^{210}Pb in biological materials is also described. (P.C.H.)

25949 EXTRACTION AND REFINING OF URANIUM. Peterson, A. (Aktiebolaget Atomenergi, Stockholm). Svensk Kem. Tidskr., 79: 195-206(1967). (In Swedish).

Research and development work at the Swedish Atomic Energy Company on extraction of uranium from shale, and the refining of uranium concentrate into uranium dioxide of nuclear grade is reviewed. (auth)

25950 DETERMINATION OF ISOTOPE SEPARATION FACTORS AT ELEVATED PRESSURES. Basmadjian, Diran (Univ. of Toronto); Pogorski, L. A. Ind. Eng. Chem., Fundament., 6: 313-15(May 1967).

The effect of pressure in the determination of isotope relative volatilities, α, by various methods is discussed. For a particular value of α and of the fractional liquid volume, ϕ, remaining in the still, the relative enrichment $(x^0-x)/x^0$ obtained by Rayleigh distillation decreases appreciably with an increase in pressure, because of the effect of vapor phase holdup. The latter can be significant even at 1 atm and must be taken into account in high precision measurements of separation factors by this method. Rayleigh distillation is inferior to the single-stage method near the critical point and has no more than marginal advantages at lower pressures. (auth)

25951 ISOTOPE SEPARATION BY MULTIPLE CONTACT. I. ANALYTICAL PROCEDURE FOR REVERSE FRONTAL PROCESS. Shimokawa, Junichi; Kobayashi, Fumiaki (Japan Atomic Energy Research Inst., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 4: 63-75(Feb. 1967).

An analytical procedure for the reverse frontal process was developed for the case in which a finite amount of one chemical substance is equilibrated isotopically step by step with the same amount of another substance, and the isotope equilibrium separation factor remains constant throughout the exchange. The isotope effect between two phases was taken into consideration in the mathematical development. Equations for the isotope abundance ratios of materials at the refluxing position and at the closing part of the effluent curve were obtained in simple form. An approximate estimate for the number of units and for the separation factor were obtained by drawing the effluent curve from experiment. A completely separated sample could not be obtained so long as the number of units was finite. (auth)

25952 STUDIES ON REMOVAL OF RADIOACTIVE MIST BY PLATE COLUMN. Mitsuishi, Nobuo; Fukumoto, Tsutomu; Hamada, Naoto (Kyushu Univ., Fukuoka). J. Nucl. Sci. Technol. (Tokyo), 4: 74-83(Feb. 1967).

A study was made on entrainment, in which the probability of mist passing through a plate is considered. A mathematical analysis was performed for large diameter column, that is, one in which consideration is given to backmixing in a plate column. The analysis and subsequent examination revealed that the decontamination factor, D.F., increases as the state of the liquid changes from a condition of complete mixing to that of plug flow. (auth)

25953 FIXATION OF RADIOACTIVE WASTES IN CONCRETE. Schejbalova, Ludmila (Inst. for Nuclear Research, Czechoslovak Academy of Sciences, Rez); Novotny, Jaroslav. Jad. Energ., 13: 87-92(Mar. 1967). (In Czech).

Fixation of radioactive waste concentrates and slurries in various types of concrete was analyzed. The influence of the chemical composition of the concentrates and slurries on the mechanical properties of the hardened cement and on washing out of the radioactive substances was analyzed. The best results were obtained with Portland concrete 350. Aging of the hardened cement caused a decrease in the elution of the radioactive substances. (tr-auth)

25954 EFFICIENT THORIUM AND RARE EARTH EXTRACTION FROM MONAZITES BY ALKALI TREATMENT. Meerson, G. A.; Hek, Li-mang. Izv. Akad. Nauk SSSR, Metal., No. 1, 42-8 (Jan.-Feb. 1967). (In Russian).

A maximum solubility of $Th(OH_4)$ and rare earth hydroxides in HCl was achieved by alkaline decomposition of monazite treated in ball mills above 150°C. The method developed for intensified decomposition of monazite in heated ball mills at 170 to 200°C (without preliminary crushing) secured a complete thorium and rare earth extraction into hydrochloric acid solution after a single treatment using about 150% sodium hydroxide, as compared to the theoretical. A selective dissolution of rare earth by acid treatment of the product from sodium hydroxide-decomposed monazite, followed by selective precipitation of $Th(OH)_4$ from the acid solution extracts practically all thorium into the concentrate with the ratio $ThO_2 : (R.E.)_2O_3 = 10 : 1$. (R.V.J.)

25955 EXCHANGE PROPERTIES OF URANIUM FERROCYANIDE. Krtil, J. (Inst. for Nuclear Research, Czechoslovak Academy of Sciences, Rez). Radiochim. Acta, 7: 30-3 (Mar. 1967).

Uranium ferrocyanide, precipitated from uranyl nitrate by ferrocyanide acid in acid solution, possessed the ability of sorbing various ions. Alkali metals, especially rubidium and cesium, had the highest sorption affinity. The sorption of Cs, Rb, Sr, and Ce on this sorbent and the effect of acidity and ammonium ions on the sorption are described. Maximum sorption capacity of the ions studied under static conditions, the selectivity coefficients for exchange of Rb and Cs on this sorbent, the separation factors for mutual distribution, and their separation from Sr and Ce were determined. (auth)

25956 EXTRACTION REACTION FOR Hg, U, Pb, AND Au WITH POLYGLYCOL AND ITS DERIVATIVES. Ziegler, Max; Winkler, Horst; Rittner, Walter; Wilkening, Hans H. (Univ., Goettingen, Ger.). Naturwissenschaften, 54: 141(Mar. 1967). (In German).

Hg(II) salts can be extracted as the saccharinate complex in the pH range from 1 to 5.5 by oxonation of the ether oxygen of polyglycol. U can be extracted as $[UO_2(SCN)_4]^{2-}$ in the strongly acid range. Pb can be extracted with polyethylene glycol as $[Pb(SCN)_3]^-$ or $[Pb(SCN)_4]^-$. Au is extracted with CH_2Cl_2 using polypropylene glycol as $[AuBr_4]^-$ in the pH range from 1 to 3. (J.S.R.)

25957 STUDIES OF URANIUM SEPARATION BY CONVERSION INTO CARBONATE $[UO_2(CO_3)_3]^{4-}$ COMPLEX. THORIUM-HYDROXIDE SORPTION. Upor, Endre; Nagy, Gyula. Magyar Kem. Foly., 73: 20-5(Jan. 1967). (In Hungarian).

The degree of sorption of uranium in the carbonate conversion separation process depends on the concentration of the carbonate in the solution and the pH. When the alkali metal carbonate concentration is higher than 0.2 $\underline{M}$ in $Fe(OH)_3$ the losses are smaller. During a study of the dependence of the sorption on the solution pH in the range from 9.2 to 10.2, a minimum was observed, then after slow increase of the sorption up to 12.7 pH a maximum was observed, then sorption again decreased. Before the maximum determinative processes, sorptive hydrolysis of the carbonate complex appeared and after the maximum the dissolution occurred because of the increase of the hydroxyl ions. If the dependence is plotted against the actual pOH, the sites of the maxima for different temperatures coincide. Although the separation of uranium from $Fe(OH)_3$ during optimum conditions can be considered complete, during analysis of the mineral ores losses are inevitable. The desorptive effects of thorium were detected. The desorptive effect was explained by the fact that in the presence of thorium the capacity of the precipitate to bind the carbonate is increased and the sorption of the hydroxide ions is decreased. This effect is specific. (tr-auth)

25958 INVESTIGATIONS OF THE DECOMPOSITION OF MONAZITE BY HEATING WITH CARBON AND QUARTZ. Holzapfel, H.; Richter, H.; Schaefer, D.; Werner, G. (Karl-

Marx-Univ., Leipzig). J. Prakt. Chem., 34: 83-90(1966). (In German).

The reaction of monazite with C and quartz was studied at temperatures between 1400 and 1700°C. Silicates of the rare earths and Th were formed in addition to elemental P. Studies at various compositions of mixtures were carried out with sintered blocks and melts; in the latter first-order appearance of P was observed. The $T_{1/2}$ of these reactions varied from 1840 min for one mixture at 1400°C to 2.7 min for another at 1700°C. The residues could be digested by heating with concentrated HCl for 3 hr, with complete decomposition if residual P was <5%. Treatment of the briquetted solid samples is also described. (BBB)

25959 CANDIDATE FOR SECOND-GENERATION FUEL-REPROCESSING PLANTS. Jonke, A. A.; Levenson, M.; Levitz, N. M.; Steindler, M. J.; Vogel, R. C. (Argonne National Lab., Ill.). Nucleonics, 25: No. 5, 58-63(May 1967).

The status of reprocessing methods for high-enrichment fuels used in mobile power reactors and research and test reactors and the low-enrichment fuels used in light-water power reactors is described. Nonaqueous processes based on volatility metal fluorides are technically feasible. Several advantages offered by fluoride volatility processing are: no degradation of the reactants by radiation; reduced fuel inventory; more economic processing; and direct production of solid waste products. Modified solvent extraction techniques could handle intense radiation associated with high-burnup commercial power reactor fuels; however, economically solvent extraction may have difficulty in competing with the newer processes. The AEC program for Pu fuels is discussed. (D.H.M.)

25960 ELECTRODIALYTIC METHOD FOR SEPARATING AND ENRICHING ISOTOPES. (to Asahi Kasei Kogyo Kabushiki Kaisha). British Patent 1,066,377. Apr. 26, 1967. Priority date June 21, 1963, Japan.

A method for separating or enriching isotopes existing as ions in solution comprises applying a potential gradient between an anode and cathode electrically connected to opposite ends of a cation or anion exchange material, which has a large size in at least two dimensions so that a direct current is passed through the material. At least two different ionic solutions containing the isotopes to be separated or enriched are fed alternatively to the end of the resin material connected to the electrode of the same polarity as the ions. The feed material is introduced in such a manner as to produce a number of alternate migration bands containing, respectively, the ions of the different solutions. These bands migrate through the resin material and are divided as they arrive at the other end into portions containing a different concentration of the isotopic ions, and the portions are collected separately. (B.L.M.)

25961 PROCESS OF PREPARING AN ADSORBENT. Moore, Raymond H. (to U. S. Atomic Energy Commission). U. S. Patent 3,322,563. May 30, 1967.

A process was developed for preparing an ion exchange material by contacting silica with an aqueous slurry of uranyl phosphate to impregnate the silica, which is then dried at a temperature of between 130 and 175°C. (AEC)

25962 DISTILLATION METHOD FOR REPROCESSING MOLTEN SALT REACTOR FUELS. Kelly, M. J. (to U. S. Atomic Energy Commission). U. S. Patent 3,310,500. Mar. 21, 1967.

A method for reprocessing spent molten-salt reactor fuels containing fission products comprises vacuum distilling the molten salt at a system pressure less than 100 μ Hg. (AEC)

25963 DISTILLATION APPARATUS. (to American Machine and Foundry Co.). British Patent 1,065,718. Apr. 19, 1967. Priority date July 3, 1963, United States.

A distillation plant particularly for distillation of seawater includes a horizontally and laterally chambered evaporator, which will provide distillate in an associated condenser of purity equal to that produced in vertically disposed multi-chambered conventional apparatus. A transverse baffle in the evaporator defines first and second chambers. Heating means are provided in the lower portion of the first chamber and the baffle is perforated in the upper portion to permit steam passage from the second chamber to the condenser shell. (B.L.M.)

25964 ELECTROLYTIC DEPOSITION OF ACTINIDE OXIDES. Kleinpeter, John H.; Jansen, George Jr. (to U. S. Atomic Energy Commission). U. S. Patent 3,314,865. Apr. 18, 1967.

A process is described for electrolytically separating pure actinide oxides by cathodic deposition from a molten alkali metal chloride while passing chlorinating gas through the melt using graphite electrodes of which the cathode has been coated with pyrolytic carbon to ease removal of the actinide oxides. (AEC)

25965 FRESH WATER FROM SALINE WATERS. The Political, Social, Engineering, and Economic Aspects of Desalination. Sporn, Philip. The Commonwealth and International Library. New York, Pergamon Press, 1966. 45p. $2.45.

A review of water desalination and combined power operation and desalination is presented. Topics discussed are: U. S. water supply and its uses; some basic concepts of desalination; history of desalination; technical principles; multi-stage flash distillation; principles of combining power generation and distillation; thermodynamic basis for integrated operation; and economics of nuclear power in power and distillation. Analytical diagrams in color are included. (J.G.B.)

25966 DISSOLUTION OF NUCLEAR FUEL. (to United States Atomic Energy Commission). British Patent 1,068,104. May 10, 1967. Priority date Sept. 17, 1964, United States.

A process for dissolving Al-containing nuclear fuel consists of immersing the fuel in HNO_3 having a concentration between 0.8 and 1.2$\underline{M}$ having a concentration of mercuric ion catalyst between 0.003 and 0.015$\underline{M}$ at a temperature at least above 70°C and preferably boiling. After the fuel assumes a grey color, concentrated HNO_3 is added until a concentration of between 4 and 6$\underline{M}$ is obtained. Heating is continued until the fuel is dissolved. (B.L.M.)

25967 SEPARATING ISOTOPES BY ELECTRODIALYSIS. (to Asahi Kasei Kogyo Kabushiki Kaisha). British Patent 1,067,567. May 3, 1967. Priority date Aug. 2, 1963, Japan.

A process is described for separating isotopes except those of rare gas elements, especially isotopes of U, Li, Ca, B, H, N, Cl, and C, by utilizing multi-cell electrodialysis apparatus. The apparatus comprises alternating resalting and concentrating compartments arranged between a cathode and an anode. Each desalting compartment has an anion exchange membrane on its anode side and a cathode exchange membrane on its cathode side, and each concentrating compartment has the membranes reversed. The solution to be separated is fed into an input desalting compartment, and a direct electric current is passed across the apparatus between the electrodes so that isotopic anions and cations of smaller mass migrate more rapidly through the anion exchange membranes and cation exchange membranes respectively to the adjacent concentrating compartments than the isotopic ions of larger mass. The isotopic ions of smaller mass are obtained from a compartment spaced from the input desalting compartment in the direction of electromigration of the isotopic ions, and the ions of larger mass are obtained from a compartment spaced from the input compartment in the opposite direction of electromigration of the isotopic ions. (B.L.M.)

25968 IRRADIATED FUEL REPROCESSING. (to General Electric Co.). British Patent 1,067,435. May 3, 1967. Priority date Dec. 26, 1962, United States.

In a process for separating fission products from Pu–U values in an aqueous HNO_3 solution of irradiated nuclear fuel, the solution is adjusted to between 6 and 8$\underline{M}$ HNO_3 and contacted with a strong-base quarternary amine-type anion exchange resin to retain the Pu and a trace of the fission products leaving a Pu-free feed effluent containing U and substantially all the fission products. The Pu and trace of fission products are eluted from the first resin with 0.4 to 0.8$\underline{M}$ HNO_3 to produce a first elution effluent, which is adjusted to 6 to 8$\underline{M}$ HNO_3 and contacted with a second anion exchange resin to retain Pu and leave the second feed effluent containing trace fission products. The Pu-free first feed effluent is evaporated and calcined to produce anhydrous mixed oxides of U and fission products, which are fluorinated to produce mixed fluorides and then separated by fractionation to produce separate products. The Pu is eluted from the second resin with 0.4 to 0.8$\underline{M}$ HNO_3 to yield decontaminated Pu as a product. (B.L.M.)

25969 METHOD OF SEPARATION OF URANIUM FROM PLUTONIUM. Bathellier, Andre (to Commissariat a l'Energie Atomique). British Patent 1,068,969. May 17, 1967. Priority date Nov. 26, 1963, France.

A method is described for the separation of U and Pu contained in an organic phase consisting of TBP diluted in a solvent and containing the U and Pu as nitrates in the +4 state. The organic phase is contacted with an aqueous phase containing nitrate ions in a concentration range of 0.5 to 3.5$\underline{N}$ and sulfate ions in a concentration range of 0.1 to 2.5$\underline{N}$. The concentration of Pu in the organic phase must be within the range of 0.005 to 5 g/l, and the concentration of U must be in the concentration range of 10 to 130 g/l. (B.L.M.)

25970 IMPROVED MULTISTAGE FLASH EVAPORATOR. (to United States Atomic Energy Commission). British Patent 1,067,407. May 3, 1967. Priority date July 28, 1964, United States.

In a multistage flash evaporator for desalination of water, brine

heated by a primary heat source is fed to a series of multilevel trays at one end of the evaporator shell and flows through successive stages defined by compartments formed in the common chamber of the evaporator shell at progressively lower pressures to flash and produce vapor. Condensing coils are provided on either side of the tier of trays to condense the vapor, which is then collected in common troughs at the base of the shell. The feed is circulated through the condenser coils countercurrent to brine flow in the trays to serve the dual purpose of condensing the vapors and pre-heating the feed. (B.L.M.)

EARTH SCIENCES

Geology

Refer also to abstracts 25784, 25997, and 26066.

25971 (BNWL-CC-925) PLUTONIUM AND AMERICIUM MOBILITY IN SOILS. **Hajek, B. F. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Nov. 28, 1966. Contract AT(45-1)-1830. 9p. Dep. CFSTI.**

The fraction of soil Pu which can be readily moved by an invading solution, soil α activity movement by diffusion and Am leaching characteristics in soil were determined. Diffusion and leaching experiments show that only a small amount of Pu is mobile. About 0.1% of the Pu can be leached by invading ground water; the leach rate is slow and Pu migration after leaching into lower soil layers is ~10^4 times less than the transporting solution velocity. Movement is negligible in a 10 yr period. A larger fraction of Am, ~7.5%, is leached by ground water. Alpha activity distribution coefficients between soil and groundwater are greater than ^{4}10ml/g, indicating that the ratio of solution movement to α activity movement also will be of this magnitude. (F.S.)

25972 (EUR-3130.f(Vol.4)) ETUDE DU CHARRIAGE D'UN ECOULEMENT PAR TRACEURS RADIOACTIFS. **Rapport Final. (Bed Material Transport Study by Tracers. Final Report). Danion, J.; Heuzel, M. (Electricite de France, Paris). 1966. 30p. (In French). Dep. mn.**

Methods of measuring bed-material movements in a waterway are reported. Luminescent and radioactive tracers used are discussed. The transport of bed-material in the Loire at the site EDF-4 nuclear power plant was studied in 1963 for the sedimentological calibration of a model constructed in the laboratory for defining the layout of the water intake. (F.S.)

25973 (NP-15085) INVESTIGATION OF THE ION ADSORPTION CHARACTERISTICS OF SOILS. **Final Report. (International Atomic Energy Agency, Vienna (Austria). State Agricultural Univ., Wageningen (Netherlands). Lab. of Soils and Fertilizers). [1964]. Contract 123/RB. 81p. Dep.**

Research on several aspects of ion adsorption phenomena occurring in soils and clays with special emphasis on the use of radioactive tracers is described. The following topics are discussed: conditions necessary for accurate determination of the activity concentration of soft β emitters, notably $^{32}SO_4$; problems arising from the use of very short half-life isotopes such as ^{42}K or extremely long half-life isotopes such as ^{40}K; the isotopic exchange of ^{40}K in illitic clay; exchangeable Ca in calcareous and gypseous soils using tracer techniques; diffusion of ^{45}Ca in calcite crystals; application of tracer techniques in the study of anion adsorption characteristics of soils and clays using Cl, SO_4, and PO_4 anions; and the movement of Ca and Na ions in soil columns during leaching with simulated irrigation waters. (F.S.)

25974 GEOTHERMAL AND PETROGENETIC IMPLICATIONS OF THE ANALYSIS OF THE DISTRIBUTION RELATIONSHIP BETWEEN THORIUM AND URANIUM. **Masuda, Akimasa (Tokyo Univ.). Tectonophysics, 2: 69-81(1965).**

Partition coefficients for Th and U were determined from the Th and U data reported by Heier; and the genetic relations between tholeiite, high-alumina basalt, and alkali olivine basalt of Japan are discussed in the light of the resulting partition coefficients. Radioactive heat production was estimated as a function of the depth within the earth. Distribution of the radioactive heat sources was estimated after assuming that the earth encountered a complete melting at its primeval age, the mantle grew upwards from the bottom through fixation of crystals segregated from the melt, and the partition coefficients for minor elements between the melt and the forming crystals were approximately constant for the process of the mantle growth. Calculations showed that the total heat source for mantle plus crust is 58 to 66% of that calculated for the perfect chondritic earth model, and 18.5 to 22% of the total heat source is reserved below 600 Km in the mantle. The original depths for tholeiite, high-alumina basalt, and alkali olivine basalt from Japan were estimated. Considerations from the partition coefficients for U and Th, coupled with the interpretations of earlier Pb isotope data, suggest that the tholeiite of Japan corresponds to the aggregate of crystals separated from the melt of a high-alumina basalt, while the alkali olivine basalt of Japan was generated by the partial melting of a high-alumina basalt. (BBB)

25975 ABUNDANCE OF RADIOACTIVE ELEMENTS IN CRYSTALLINE SHIELD ROCKS. **Fahrig, W. F.; Eade, K. E. Adams, J. A. S. Nature, 214: 1002-3(June 3, 1967).**

Data on the major element composition of the crystalline surface rocks of 200,000 square miles of the Canadian Shield in northern Quebec indicate that, relative to rocks of amphibolite facies in this area, the gneisses of granulite facies are depleted in K, water, and silica, and enriched in Al, total Fe, P, Mg, Ca, and Ti. These differences were thought to indicate a chemical zoning of the Earth's crust in response to regional metamorphism. The abundances of trace elements in these rocks, and in particular Th, U, and K, are of interest. Averages for the abundances of these radioactive elements are tabulated. One problem in interpreting the chemical data is whether the Th and U contents of these near surface samples have remained unchanged since the rocks were last regionally metamorphosed. The data indicate significantly lower average concentrations of Th, U, and possibly K, in rocks of granulite facies than in surrounding rocks of amphibolite facies. A higher than "normal" overall Th/U ratio is indicated. It is suggested that, because of the greater solubility of the oxidized uranyl complex ion, uranium is easier to remove in metamorphic processes. The Th/U ratios are lower in rocks of amphibolite facies than in rocks of granulite facies. The data appear to indicate that U is more strongly fractionated than Th during high-grade regional metamorphism. A major question is whether most shield areas if eroded to moderate depths (say 5 miles) would expose high-grade gneisses similar to those investigated. If so, then the bulk of the continental crust is likely to have radioactive element abundances similar to the surface rocks of New Quebec. (UK)

25976 DEUTERIUM AND ^{18}O IN NATURAL WATERS: ANALYSES COMPARED. **Halevy, E.; Payne, B. R. (International Atomic Energy Agency, Vienna). Science, 156: 669(May 5, 1967).**

The IAEA recently compared mass-spectrometric analyses of isotope ratios of deuterium and ^{18}O in natural waters. Three samples; ground water, a mixture of two surface samples collected from the Kattegat and the Baltic Sea, and surface water from Greenland; were sent to twelve laboratories for analysis. The results are presented in tabular form. (W.D.M.)

25977 EFFECT OF SOIL MOISTURE ON THE STRUCTURE OF THE GAMMA FIELD IN THE ATMOSPHERE NEAR THE EARTH. **Kogan, R. M.; Fridman, Sh. D. (Inst. of Applied Geophysics, Moscow). Izv. Akad. Nauk SSSR, Fiz. Zemli, No. 3, 82-5(Mar. 1967). (In Russian).**

On assuming a constant concentration of radioactivity in the soil, the intensity or primary radiation is a function only of the soil moisture ω: $I_0 = I_0 f(\omega)$. Here I_0 is the radiation intensity at the earth's surface at $\omega = 0$. The function $f(\omega)$ has the form: $f(\omega) = 1/(1 + k\omega)$. Here k is the ratio of electron densities of soil to water, and is numerically equal to 1.1. This relationship is valid also for scattered radiation and for measurements made at a height h above the ground. Due to seasonal changes in the soil moisture content, an analysis of gamma ray counting data over a six month period showed that the maximum error in the measured gamma intensity was 8 to 10% in the southern part, and 10 to 15% in the eastern part of Russian. Hence it is necessary to take into account seasonal variations in soil moisture for accurate measurements (error of less than 5 to 10%). In rainy periods the gamma flux is substantially decreased, and the energy composition of the gamma quanta is distorted. A wait of 16 to 30 hours after a rainfall is advisable in taking gamma ray field measurements so as to have a normal soil moisture. (TTT)

25978 THE ABSOLUTE AGE OF THE ARALIAN SEA, FIGURED OUT FROM UNBALANCED URANIUM. **Chalov, P. I.; Merkulova, K. I.; Tuzova, T. V. (Inst. of Physics and Mathematics, Frunze, USSR). Dokl. Akad. Nauk SSSR, 169: 89-91(July 1, 1966). (In Russian).**

The absolute geochronological age of the Aral Sea was determined by the nonequilibrium isotopic ratio of $^{234}U/^{238}U$ in the basin waters and in the bottom sediments. The results indicated an age of 150 ± 30 thousand years for the Aral Sea and 110 ± 40 thousand years and 320 ± 50 thousand years for the Issyk-Kul and Chatyr-Kul Lakes, respectively. The relative age of the Issyk-Kul Lake is in good agreement with the hydrochemical data. (R.V.J.)

25979 USE OF NEUTRON CAPTURE γ-RAY SPECTROMETRY FOR INVESTIGATING BROWN-COAL SEAMS IN THE BOREHOLE. PART I. Eife, Karl-Heinz (Inst. for Petroleum Chemistry, Moscow). Z. Angew. Geol., 12: 530-6(1966). (In German).

The possibilities of applying neutron capture γ-ray spectrometry to the location of brown-coal seams in the borehole and to the determination of their ash content were investigated. A discussion of the method is followed by a description of practical measurements from the brown-coal basin of Moscow, showing that brown-coal seams, owing to a pronounced minimum of the neutron-γ-radiation intensity, can be unambiguously located when recording fast-neutron γ rays within the energy range $E_\gamma = 3$ to 10 MeV. The relative intensity $I_{n\gamma}^{coal}/I_{n\gamma}^{clay}$ ($E_\gamma > 3$ MeV) very well correlated with the ash content. The error occurring during the determination of the ash content was ~3% of ash (wt) and did not exceed the systematic error of the ash content demonstrated by core drillings, which was about ±6% of ash (wt) for the Moscow basin. Factors influencing the accuracy of determination of the ash content and requirements to be satisfied by the measuring apparatus were also investigated. (BBB)

25980 NATURAL RESERVOIRS AND THEIR CHARACTERISTICS. Eriksson, E. (Univ. of Stockholm). Geofis. Int. (Mexico), 1: 27-43(1961).

The circulation of radionuclides in natural reservoirs is examined theoretically and some expression derived which allow quantitative evaluation of such circulation. Some considerations on reservoirs and their characteristics are examined to assess the possibility of using the box-model approach in circulation problems as well as alternative methods. The presence in nature of radioactive cosmic-produced elements provides an internal clock for the matter in various reservoirs. A reservoir residence time based upon radioactivity measurements can be computed and will be correct only if internal mixing is absent or if the linear approximation of the decay function is permitted. A sample consisting of a mixture of young and old matter will always give an apparent mean radioactive age which is smaller than the true mean age. A mathematical approach is provided which can be used when a tracer is released on a large scale. As an example, it is mentioned that the earth's groundwater resources could have been investigated globally if sampling of precipitation and river water for tritium analysis had been done continuously over the world since the first hydrogen bomb was detonated. It is still possible to gain some information if the rate of addition in the past can be reconstructed. Some data on use of ^{14}C measurements to study carbon reservoirs are also discussed. (BBB)

25981 RESEARCH ON THE GEOLOGICAL AND CHEMICAL CHARACTERISTICS OF A SITE IN RELATION TO THE POSSIBILITY OF RADIOACTIVE CONTAMINATION OF THE AQUIFEROUS LAYER. Lenzi, Giuseppe. pp 451-64 of Atti del Convegno sul Problema delle Acque in Italia. Parte I. Le Acque Sotterranee. Milan, Tamburini Editore, 1965. (In Italian). (RT-PROT-(66)20).

A method for investigation of a site with respect to the possibility of radioactive contamination of the aquiferous layer is outlined. The site characteristics and the chemical-physical characteristics of a terrain for the adsorption of radionuclides are outlined. The results of a study made at Casaccia are summarized. (J.S.R.)

25982 SOME CONSIDERATIONS OF RADIATION CONTAMINATION FROM FALLOUT IN UNDERGROUND WATER. Cigna, Arrigo A. (CNEN, Casaccia, Italy). pp 439-50 of Atti del Convegno sul Problema delle Acque in Italia. Parte I. Le Acque Sotterranee. Milan, Tamburini Editore, 1965. (In Italian). (RT-PROT-(66)21).

The characteristics of radioactive contaminations are described and compared with other types of contaminations. Some values for reduction factors of the radioactive concentrations found in rainwater, surface water, and subterranean water are reported. The efficiency of some types of filtrating beds is considered from this viewpoint. (tr-auth)

25983 ABSORPTION OF RADIOACTIVE STRONTIUM BY SOIL, ESPECIALLY IN RELATION TO NATIVE CALCIUM. Tensho, Kiyoshi; Yeh, Ko-ling; Mitsui, Shingo (Tokyo Univ.). Soil Sci. Plant Nutr. (Tokyo), 7: 152-6(Dec. 1961).

After shaking soil suspensions with carrier-free ^{89}Sr, its absorption by soil was examined in relation to soil Ca content and soil pH. The soil pH was changed by adding HCl, NaOH, or Ca$(OH)_2$. The distribution ratios of ^{89}Sr for 7 soils ranged from 0.7 to 3.9%, 72 to 94%, and 5.4 to 25% for the nonabsorbable, exchangeable, and nonexchangeable fractions respectively. With regard to the ratio ^{89}Sr to Ca, a significant difference was found between nonabsorbable and exchangeable fractions, and the degree of this unequal distribution between the 2 fractions was not identical among the soils tested. Maximum ^{89}Sr absorption by 3 soils was obtained by the addition of a small amount of NaOH to give a pH value of about 6.5 to 7, but its absorption was scarcely influenced by $Ca(OH)_2$. The ratio of ^{89}Sr to Ca of the nonabsorbable fraction was increased by lowering soil pH, and the reverse was found for the addition of $Ca(OH)_2$ and a small amount of NaOH. Autoradiographic experiments showed that the ^{89}Sr in distilled water was accumulated on the surface of soil column, and the deposited ^{89}Sr barely migrated after washing with distilled water. Appreciable downward movement, however, was caused by washing with water containing Ca. (BBB)

25984 SOME DATA ON MICAS FROM TRACKS OF URANIUM FISSION FRAGMENTS. Berzina, I. G. Dokl. Akad. Nauk SSSR, 170: 681-3(Sept. 21, 1966). (In Russian).

The spontaneous fission of uranium, the concentration of which is known, was used for the classification of micas and for the determination of some of their characteristics. The study was based on the fact that cleavage surfaces of micas always exhibit tracks due to the spontaneous fission of uranium; thus, a specimen aged 250×10^6 years and a uranium concentration of about 10^{-6}% of uranium may contain 10^4 tracks per cm^2. About 1500 measurements were carried out on 200 specimens, including muscovites, lepidolites, biotites, vermiculites, gilbertites, etc. Hydrofluoric acid was used to etch the specimens, examining the correlation between the orientation of the etched figures and the direction of the optical axis by means of a polarizing microscope. A definite correlation could be established for muscovite and zinnwaldite specimens; in the other specimens determination of the orientation of the optical axis was found to be difficult. It appears thus possible to separate and classify micas on the basis of short examination of etched specimens; the method requires only a few minutes of examination and simple, generally available equipment. (TTT)

25985 TRACE ELEMENT FRACTIONATION BY SUSPENDED MATTER IN WATER. Eichholz, G. G.; Craft, T. F.; Galli, Ann N. (Georgia Inst. of Tech., Atlanta). Geochim. Cosmochim. Acta, 31: 737-45(May 1967).

Fractionation of trace elements by silt and sediment particles in natural waters was studied by means of radioactive tracers. Partition of dissolved tracer ions between sediments and water was investigated, as well as the relative changes in concentration of fission product ions in a mixture after contact with suspended particles in naturally occurring abundances. Gamma spectra were obtained to illustrate the extent of separation occurring as a result of preferential adsorption of some of the fission products on clay silt particles. In waters with a high organic content, the pattern of fractionation was different, as expected, with a higher extraction of anions and anionic complexes The results have an important bearing on the degree of self-purification by bottom sediments in turbulent, polluted streams. Careful distinction is required in analytical reports between truly dissolved elements and total "dissolved solids," which may include ions adsorbed on submicron silt particles. (auth)

Meteorology

Refer also to abstracts 25977, 26087, and 26117.

25986 (ANL-7220, pp 89-96) ANALYSIS OF SMOKE PLUME PHOTOGRAPHS. Carson, J. E.; Moses, H. (Argonne National Lab., Ill.).

Smoke plume photographs, taken at 15 sec. intervals during 4 min sampling periods, were analyzed for the plume height and area as related to the parameters of effluent temperature, stack velocity, meteorological conditions, and distance from the stack. Tables of the results are given. (L.C.L.)

25987 (ANL-7220, pp 96-9) CALCULATION OF EFFECTIVE STACK HEIGHT. Moses, H.; Carson, J. E.; Thomas, F. W.; Frizzola, J. A.; Briggs, G. A.; Strom, G. H. (Argonne National Lab., Ill.).

Empirical smoke plume rise data from nine sources were plotted for stable, unstable, and neutral atmospheric conditions. Equations were derived for calculating the effective stack height for each of these atmospheric conditions and with the known quantities of stack height and diameter, stack effluent velocity, heat emission rate, and wind velocity. (L.C.L.)

25988 (ANL-7220, pp 106-15) DIFFUSION OF A SCALE MODEL SMOKE PLUME. Strom, Gordon H.; Kaplin, Edward J. (Argonne National Lab., Ill.).

A series of scale model wind tunnel experiments on the diffusion of the smoke plume from a model of the Argonne experimental smoke stack were performed. The results are presented and compared with Argonne prototype field data. The results are encouraging for the achievement of accurate modeling of atmospheric motions important to the dispersal of pollution in the atmosphere. (L.C.L.)

25989 (BNWL-SA-1045) VALIDITY OF AIR SAMPLES AS AFFECTED BY ANISOKINETIC SAMPLING AND DEPOSITION WITHIN THE SAMPLING LINE. Sehmel, G. A. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr. 24, 1967. Contract AT(45-1)-1830. 15p. (CONF-670704-2). Dep. CFSTI.

From IAEA Symposium on Instruments and Techniques for the Assessment of Airborne Radioactivity in Nuclear Operations, Vienna, Austria.

Three sources of error in sampling airborne particles were investigated. Particle sizes from 1 to 28 micron diameter produced by a spinning disc aerosol generator were used. The three sources of error studied were anisokinetic sampling, deposition within a curved sampling probe, and deposition within a sample delivery line. Anisokinetic sampling error was determined for sampling rates corresponding to 0.3 to 10 times isokinetic flow for air velocities of 2.5 to 30 mph. The sampling error is significant for large particles, and contrary to some previously reported studies may also be significant in some situations for particles as small as 1 to 5 micron. Flow rates and particle sizes are shown which result in a large fraction of particle deposition within a 0.4 in. ID curved sampling probe. The deposition may be significant for both laminar and turbulent flows. Particle deposition within straight vertical tubes was measured for tube sizes from 0.2 to 2.8 in. ID. Deposition is significant for turbulent flow and increases rapidly with flow rate and particle size. The axial flux profile of particles was measured. In many instances, the axial flux profile of particles within a 2.8 in. ID tube was nearly the inverse of the velocity profile. In these cases an annulus within about 0.2 in. of the wall had a much higher concentration of particles than did the center region of the tube. This inverse profile was observed under conditions of relatively high net deposition accompanied by significant re-entrainment. Normal flux profiles with a low flux near the wall were observed for small particles and for tacky surfaced tubes. The particle flux profiles result from an interaction of deposition, re-entrainment, and air turbulence. This study points out the complex nature of these interactions and emphasizes the need to know in considerable detail the nature of the particles and their behavior to achieve truly representative sampling. (auth)

25990 (CEX-62.80c) SEDAN PROJECT 62.80c, AERORADIOACTIVITY SURVEY. (Edgerton, Germeshausen and Grier, Inc., Santa Barbara, Calif.). Nov. 1965. Contract AT(29-1)-1183. 16p. (EGG-1183-2062). Dep. CFSTI.

The distribution of Sedan fallout deposited on the ground from 10 to 200 miles from ground zero was determined. The fallout was shown by dose-rate contours to be asymmetric, with a steep gradient west of the midline and a very gradual gradient on the east. Gamma energy measurements made 100 ft above the ground resulted in the identification of ^{131}I, ^{132}Te, ^{132}I, ^{187}W, and ^{140}Ba–^{140}La. (auth)

25991 (ORO–3083-4) SEVERE CONVECTIVE STORMS AND THE STRATOSPHERIC SCAVENGING OF RADIOACTIVE PARTICLES. Final Report. Hall, Samuel J.; Renneke, Bruce C.; McIntyre, James R.; Saucier, Walter J. (Oklahoma Univ. Research Inst., Norman. Atmospheric Research Lab.). Dec. 1966. Contract AT(40-1)-3083. 202p. (ARL–1402-4). Dep. CFSTI.

Individual abstracts were prepared for the five papers on the evaluation of the role of thunderstorm convection and rainfall in the fallout of radioactivity from deep layers of the atmosphere. (F.S.)

For abstracts of individual papers see: 25992–25996.

25992 (ORO–3083-4, Pt.1) RADIOACTIVITY IN RAINFALL FROM CONVECTIVE STORMS. Hall, Samuel J.; Renneke, Bruce C. (Oklahoma Univ. Research Inst., Norman. Atmospheric Research Lab.). 50p.

Results of data collections of radioactivity in rainfall from convective storms for three seasons (spring 1963, 1964, and 1965) are discussed. Measures of β activity in the rain samples were obtained for each season, with total Sr and γ radiation measurements obtained only in 1964, are included. These data together with radar observation data and raingage data are used to determine the relations of storm structure, rainfall, and radioactivity. It was found that in 1963, the small rainfall amounts had the greatest β concentrations. Time profiles from 1964 and 1965 showed further that not only the small accumulations but also the rain samples collected from weak rainfall rates had relatively high concentrations. (F.S.)

25993 (ORO–3083-4, Pt.2) ISENTROPIC TRAJECTORIES OF AIR IN THUNDERSTORM ENVIRONMENTS. Hall, Samuel J.; Renneke, Bruce C.; McIntyre, James R. (Oklahoma Univ. Research Inst., Norman. Atmospheric Research Lab.). 13p.

Possible source regions for the radioactivity washed out of the atmosphere by rainfall from convective storms were studied. The following outstanding characteristics were found: low and middle level trajectories of air into thunderstorm environments originated from similar levels in the troposphere; high level trajectories which ended in the stratosphere appear to have remained in the stratosphere over their entire paths, but in several cases the trajectories indicated that air in the upper troposphere in the thunderstorm environments may have been of recent stratospheric origin. The possibility exists for upper-level entrainment of some air of recent stratospheric residence. This could enhance the radioactivity scavenging of the storm well below the divergent anvil region of the thunderstorm cloud. (F.S.)

25994 (ORO–3083-4, Pt.3) PATTERNS OF CERTAIN KINEMATIC PROPERTIES OF SQUALL LINES RELATED TO THEIR RADAR ECHOES. Hall, Samuel J. (Oklahoma Univ. Research Inst., Norman. Atmospheric Research Lab.). 25p.

Patterns of kinematic properties of two separate squall lines related to their radar echoes which were detected by the National Severe Storms Laboratory (NSSL) Beta Network were studied. The kinematic patterns appeared to have some continuity with their radar echo patterns but this continuity did not exist between cases. Differences in storm structure probably dominate this factor. There was time and space continuity in some features and a lack in others, probably due to squall line structure, interaction between storm cells, duration of existence of storm cells, network spacing, and orographic effects over the observation network. (F.S.)

25995 (ORO–3083-4, Pt.4) RADIOACTIVE FALLOUT FROM STORMS REACHING INTO THE STRATOSPHERE. Renneke, Bruce C. (Oklahoma Univ. Research Inst., Norman. Atmospheric Research Lab.). 78p.

Four stratospheric-penetrating storms were studied to determine if this type storm washes out more radioactivity than storms confined to the troposphere. Results indicated that two of these storms washed out more radioactive particles than storms confined to the troposphere. An experiment is suggested for determining the proportion of radioactivity supplied by the troposphere and the stratosphere and to clarify the stratospheric scavenging process. (F.S.)

25996 (ORO–3083-4, Pt.5) RELATIONSHIPS OF DIVERGENCE AND VORTICITY OF SURFACE WINDS TO BETA CONCENTRATION AND RAINFALL RATE. McIntyre, James R. (Oklahoma Univ. Research Inst., Norman. Atmospheric Research Lab.). 13p.

The qualitative relationships in time of divergence, vorticity, rainfall rate and β concentrations were investigated. Results indicate that rainfall rate maxima tend to occur about the time of a large increase in the divergence value computed for the station. Although features in the vorticity time profiles tended to be smaller, and in some cases not larger than the steady-state fluctuations, when large fluctuation was observed, it was in the opposite sense of the corresponding divergence value. Features in the time profiles of β concentration were found to be too short a period to be related in any sure way to the divergence time profiles. It may be that β concentrations tend to decrease with the larger increases in divergence. (F.S.)

25997 (RA–24) ONDERZOEK NAAR RADIOACTIEVE STOFFEN IN OPPERVLAKTEWATER EN NEERSLAG. MEETRESULTATEN IN 1965. **(Investigation of Radioactive Materials in Surface Waters and Precipitation. Measurement Results in 1965). Mattern, F. C. M.; Strackee, L. (Rijks Instituut voor de Volksgezondheid, Utrecht (Netherlands)). Apr. 1966. 22p. (In Dutch). Dep. mn.**

Tabulations are presented of the total β activity, ^{40}K content, total α activity, ^{90}Sr, ^{226}Ra, ^{89}Sr, ^{137}Cs, and ^{144}Ce measured in surface waters and precipitation during 1965 at various sites in the Netherlands. (J.S.R.)

25998 (RLO–1776-3) HYDROSPHERE-ATMOSPHERE RADIOCHEMICAL MEASUREMENTS. **Progress Report, April 1, 1966–April 1, 1967. Fairhall, A. W. (Washington Univ., Seattle. Dept. of Chemistry). May 1, 1967. Contract AT(45-1)-1776. 32p. Dep. CFSTI.**

Numerical analysis of the transport of debris within the stratosphere using a model which includes mean meridional motions and eddy diffusion was applied to the transport of ^{185}W from the 1958 injection into the equatorial stratosphere. Seasonal variations were revealed which showed ascending motions at the polar and tropical latitudes and subsidence at middle latitudes in winter, shifting in the spring to a weak southward drift within the lower stratosphere and with ascending motions at the equator and subsidence over the pole. During the summer, stratospheric circulation is at a minimum. Agreement between the numerical calculation and observed distribution was good. A model is given for the tropospheric mixing and exchange of CO_2 with the sea to account for the observed distribution in time and space of the ^{14}C injected into the atmosphere by the 1961 to 1962 tests. It appears that the distribution of bomb ^{14}C in the northern hemisphere troposphere can be interpreted in terms of injection of high specific activity ^{14}C from the stratosphere, air sea exchange of CO_2, and troposphere dispersion by eddy diffusion. A more complete description might have to include the effects of mean meridional circulations especially at low latitudes where eddy diffusion is smallest. (F.S.)

25999 (Y-KB-78) INNOVATIONS IN AIR MONITORING TECHNIQUES FOR LARGE-SCALE PROGRAMS. **Sanders, Merwyn (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). Jan. 11, 1967. Contract W-7405-eng-26. 24p. (CONF-670704-1). Dep. CFSTI.**

From IAEA Symposium on Instruments and Techniques for the Assessment of Airborne Radioactivity in Nuclear Operations, Vienna, Austria.

Practical and useful techniques have been developed and used for effective air monitoring in a large scale industry for toxic and radioactive particulates. One of the most successful techniques developed involves the use of Standard Holleran punched cards equipped with a window which hold a filter paper insert. The use of this card permits automation of analysis and machine data processing. Air monitoring by this system offers the following advantages compared to conventional air sampling programs: automation of analyses is provided with particular application to extensive monitoring programs; by combining records and analysis into one unit, the possibility of laboratory errors in recording and reporting results is greatly reduced; commercially available material and computer card handling equipment are utilized; the so called aperture card technique offers practical standardized procedures for collecting samples; costs of air sampling and analysis are reduced compared to conventional air monitoring programs; and the system minimizes data storage and offers easy retrieval for historical reference, statistical comparisons, and legal records. A variety of other sampling equipment is discussed which has been developed with emphasis on manpower savings and low cost of analyses without sacrificing program effectiveness. These devices include various actuating mechanisms which integrate sampling with work activities, simplified sampling equipment for remote area coverage and techniques of field analysis for specific radioactive particulates. (auth)

26000 VARIATION IN ATMOSPHERIC ^{14}C ACTIVITY RELATIVE TO A SUNSPOT-AURORAL SOLAR INDEX. **Bray, J. Roger (Grasslands Div. Dept. of Scientific and Industrial Research, Palmerston North, N. Zeal.). Science, 156: 640-2(May 5, 1967).**

Radiocarbon activity was negatively correlated ($P < 0.01$) with a sunspot–auroral index during 25 designated solar activity periods from 129 B.C. to A.D. 1964. Change in carbon-14 activity during these periods was inverse to change in solar activity in 22 of 24 instances ($P < 0.001$). Contamination from carbon-14 formed during previous solar cycles may lessen the value of carbon-14 as a climate or solar index. (auth)

26001 NATURAL BETA ACTIVITY OF ATMOSPHERIC AEROSOLS IN PLOVDIV DURING 1962 AND 1963. **Ivanova, D.; Stefanova, M.; Genkov, D. (Higher Medical Inst., Plovdiv, Bulgaria). Folia Med. (Plovdiv), 7: 252-7(1965).**

Systemic measurements were made of β activity of atmospheric aerosols in Plovdiv from the middle of 1962 to the end of 1963. It was found that the filter method is the method of choice, with the air passage through the filter for 4 hr. Beta activity was measured by several β counters. The annual course of β activity variation is shown. The maximal recorded activity was 1404 cpm. The minimum occurred at the end of winter and during spring, and the maximum during autumn. A study of the relation between concentration of radioactive substances and meteorologic changes (temperature, moisture, velocity, and direction of wind) was made. There was no clear connection between natural β activity and temperature; radioactivity increased when there was an elevation of moisture. It was reduced when the wind velocity increased; the greatest natural activity was encountered with northeast winds. (BBB)

26002 A COMPARATIVE STUDY ON THE NATURAL BETA RADIOACTIVITY OF ATMOSPHERIC AEROSOLS IN PLOVDIV. **Ivanova, D.; Stefanova, M.; Genkov, D. (Higher Medical Inst. Plovdiv, Bulgaria). Folia Med. (Plovdiv), 8: 358-64(1966).**

Systematic measurements on the natural β radioactivity variations of atmospheric aerosols in Plovdiv began in 1962 and were continued through 1965. In all, 581 air filter tests were made and the measured activity was expressed in relative units(cpm). The maximum value of the average monthly activity for 1963 and 1965 was found in November and for 1964 in December. The minimum for 1963 was in February, for 1964 in May, and for 1965 in April. The decreased vertical air turbulence exchange and the large number of misty days in autumn determined the maxima clearly seen for 1963 to 1965. The minima were caused by the increased turbulence exchange and the decreased soil exhalation of radioactivity in spring. In comparison with the maximum for 1965, the maxima for 1963 and 1964 were $\frac{1}{3}$ lower. The increased values of β radioactivity in 1965 in comparison with the preceding 2 yr are explained by the fewer windy days and by the greater number of calm days and of misty days. There was a tendency towards a decrease of radioactivity with an increase of temperature. (BBB)

26003 STUDY OF THE GAMMA-RAY SCATTERING TECHNIQUE FOR MEASURING ATMOSPHERIC DENSITY. **Gardner, R. P.; Whitaker, D. R. (Research Triangle Inst., Research Triangle Park, N. C.). Nucl. Appl., 3: 298-307(May 1967).**

The gamma scattering technique has shown promise for continuous measurement of atmospheric density from space vehicles. To understand and optimize the parameters of this technique, mathematical models were derived and used to study design parameters such as gamma source energy, source-to-detector separation, detector discriminator settings, and shield effectiveness. The predicted effects agree generally with the experimental results obtained in feasibility studies, and mathematical modeling promises to be an effective means for optimizing the design of the gamma scattering technique for measuring atmospheric density. (auth)

26004 ATMOSPHERIC DISPERSION OF FISSION PRODUCTS INCLUDING THE EFFECTS OF BUILDING DILUTION AND RADIOACTIVE DECAY. **Charak, Ira (Argonne National Lab., Ill.). Nucl. Appl., 3: 283-6(May 1967).**

Sutton's diffusion equation, which is commonly used for the computation of atmospheric dispersion of fission products, is modified to account for the effect of dilution of the fission products due to mixing of the contaminated air inside the reactor building with clean air prior to exhaust. The effect of radioactive decay is also considered. The resulting integral equation is solved for a specific example using a Romberg integration subroutine and the application of the equation to a washout calculation is described. (auth)

26005 RECOMMENDED STANDARD METHOD FOR ATMOSPHERIC SAMPLING OF FINE PARTICULATE MATTER BY FILTER MEDIA: HIGH-VOLUME SAMPLER. **Jutze, George A.; Foster, Kirk E. J. Air Pollut. Contr. Ass., 17: No. 1, 17-25 (Jan. 1967).**

A high volume sampler is described for sampling large volumes of air for suspended particulate matter. The sampler consists of a specially housed vacuum sweeper motor to which is attached a filter holder or adapter. In determining gross β activity, the 8 by 10 in. fiberglass filter is weighed and counted after 2 days to allow decay of the natural α particles. The samples are recounted after 4 to 7 days to establish the decay in terms of apparent half life of the radioactive material. Counting is accomplished with a proportional gas flow counting chamber. The use of this method and equipment permits the radioactivity of the sample and the average half life of the radioisotopes in the sample to be determined. (F.S.)

26006 ESTIMATE OF ATMOSPHERIC RADIOACTIVITY FOR 1965. **Petrovic, Pavel. Meteorol. Zpr., 19: 172-7(Dec. 1966). (In Czech).**

Data are presented on the total daily, weekly, and monthly fallout β radioactivity in the air measured during 1965. A meteorological analysis was made of atmospheric radioactivity maximums reported in the journal in the No. 1 and 3, 1964 and No. 3, 1965. (R.V.J.)

Mineralogy

26007 RADIATION DAMAGE IN ASPHALTIC URANIFEROUS MATERIALS. III. CUPRIFEROUS SCHIST FROM MANSFELD (GERMANY). **Jedwab, Jacques (Univ. Libre, Brussels). Bull. Soc. Belg. Geol. Paleontol. Hydrol., 74: 346-51(1965). (In French).**

Distribution of radioactivity in the Mansfeld schist has a discontinuous character because of inclusions of detrital origin and because of organic material. Part of the U appeared to be effectively fixed by adsorption on the organic material. The mode of association of radioactive inclusions and of nodules of carbonaceous material enveloping them is null, and suggests a rapid accretion of these nodules starting from fluid materials that are very sensitive to radiation. Illustrations of polished sections and autoradiographs are given. Active particles are almost always present in the interior of nodules, not on their periphery. (BBB)

26008 THERMOLUMINESCENCE OF SYNTHETIC FLUORITE. **Blanchard, Frank N. (Univ. of Florida, Gainesville). Amer. Mineral., 52: 371-9(Mar.-Apr. 1967).**

Certain single lanthanide species in gamma-irradiated synthetic crystals of CaF_2 causes thermoluminescent glow curves with peak temperatures and general configurations that are characteristic of the lanthanide species. Other lanthanides fail to "activate" thermoluminescence. Relative thermoluminescence efficiency for different lanthanides and some information on optimum concentration for activation of thermoluminescence are given. A "crystallization-induced" thermoluminescence and a "gamma-radiation-induced" thermoluminescence are shown to be identical in mechanism and in end results for Dy-containing CaF_2, and it is suggested that the same relation may hold for other lanthanide-containing CaF_2 crystals. Pure CaF_2 (99.99%) is shown to be thermoluminescent only at low temperatures. This study has proved helpful in understanding thermoluminescence of natural fluorite, and may aid in developing techniques for using thermoluminescence as an analytical and interpretive tool in geology. (auth)

26009 CRYSTAL STRUCTURE OF CHERALITE. **Finney, J. J. (Colorado School of Mines, Golden); Rao, N. Nagaraja. Amer. Mineral., 52: 13-19(Jan.-Feb. 1967).**

The structure of cheralite, a thorium, calcium, rare earth monazite, has been completely redetermined. Patterson sections and three-dimensional difference maps were used to determine the atomic positions, and least squares refinement of the data reduced the R-factor to 0.084. This structure is in accord with three of four previous monazite structure analyses, and the crocoite structure analysis. A relationship is apparent between increase of long Ce–O bonds and decrease of short Ce–O bonds and P–O bonds. (auth)

26010 PETROGRAPHIC INVESTIGATIONS ON THE BOGHEAD SHALES OF AUTUN. **Wolf, Monika (Geologisches Landesamt Nordrhein-Westfalen, Krefeld, Ger.). Sci. Terre, 11: 7-18(Mar. 1966). (In French).**

Gamma spectroscopic and petrographic studies were conducted on the carbonaceous material in the U- and Th-bearing Boghead shales at Autun, France. These studies revealed some features of the changes caused in algae by radiation. Diminishing intensity and increasingly darker fluorescence indicated a destruction of the Brueckenstrukturen (bridge structures). Increasing light absorption in thin sections and greater reflection capacity in polished sections suggested that the existing ring systems are preserved or have grown still larger. Assuming that the destruction of the hydrocarbon chains consists of a splitting off of methane molecules and carbon enrichment, which appears to be substantiated by previous results, the petrographic data suggest that the alteration of plant material due to radiation results in increased coalification. (BBB)

26011 ADDITIONAL MEASUREMENTS OF THE ISOTOPIC COMPOSITION OF LEAD FROM STRATIFORM DEPOSITS. **Ostic, R. G. (Carnegie Inst. of Tech., Pittsburgh); Russell, R. D.; Stanton, R. L. Can. J. Earth Sci., 4: 245-69(Apr. 1967).**

An apparent correlation between lead isotope abundance characteristics and features of the deposits in which the lead is discovered was studied. Analyses were carried out on 55 galena samples, mostly from Australasian ore deposits classified as stratiform. To help clarify the interpretation, certain vein leads related to those that are stratiform were included, as was one analysis of volcanic cotunnite. Evidence is offered that all leads began their isotopic evolution in a unique primary system that has very restricted spatial variation in the ratios U/Pb and Th/Pb. Leads from certain stratiform deposits approach more closely in isotopic composition the products of the primary system than do vein leads, many of which involve extensive crustal histories that further modify the isotope ratios. The analysis presented have sufficient precision to permit a close examination of the differences in isotope ratios between stratiform leads and the products of a simplified model for the primary system. The differences are significant and important. Novel aspects of the experimental technique are discussed. (auth)

Oceanography

Refer also to abstracts 26064 and 26089.

26012 NATIONAL CONFERENCE ON THE TECHNOLOGY OF THE SEA AND SEA BED. **Atom, No. 127, 111-22(May 1967).**

The papers presented at the Conference held at the Atomic Energy Research Establishment, Harwell, England, on April 5 to 7, 1967 are reviewed. These include the following: the use of nuclear explosives for sea-bed mining; extraction of uranium and other inorganic materials from sea water; unconventional nuclear power sources; the use of fuel cells on and under the sea; nuclear reactors for underwater power; application of radioisotope tracers to spoil ground selection; and Harwell oil pollution work. (UK)

26013 ACCUMULATION AND REDISTRIBUTION OF RARE-EARTH ELEMENTS UPON THE FORMATION OF IRON–MANGANESE CONCRETIONS IN THE OCEAN. **Fomina, L. S. (Inst. of Oceanology, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 170: 1181-4(Oct. 11, 1966). (In Russian).**

The rare earth content of the widespread iron–manganese concretions in deep oceanic areas is not well known. In view of the redistribution of the elements during the formation of these concretions, the concentration changes of the rare earths were investigated on samples collected from deposits in the Pacific and Indian Oceans. The total rare earths were separated by the fluoride–oxalate method and were further identified by paper chromatography. The results indicated a wide variation of the rare earth concentration in the deposit from 0.005 to 0.040%; in the concretions, the concentrations varied between 0.146 and 0.212%. The ratio of the cerium and yttrium earths, $\Sigma Ce/\Sigma y$ was 1.6 in the deposit but in the concretions it reached a value of 6, indicating a redistribution of the rare earths. It was found that the first 3 elements of the cerium subgroup were most enriched, with an enrichment factor of about 50, while yttrium and terbium exhibited an enrichment factor of only 4.5. The concentration of the concretions was compared with that of the mother deposits, which, of course were depleted in the same elements. This fractionation of the rare earths is attributed to the changes in the chemical properties going from lanthanum to lutetium, with the decrease of the radius and the basicity decreases resulting in an increasing ability to form complexes. (TTT)

Seismology

Refer also to abstracts 25998 and 26012.

26014 (GACD–7883) SHEAR WAVE TESTING PROGRAM. **Final Summary Report. Pound, D. C.; Outcalt, E. E. (General Dynamics Corp., San Diego, Calif. General Atomic Div.). Mar. 24, 1967. Contract W-7405-eng-18. 28p. (UCRL–13289). Dep. mn. CFSTI $3.00 cy, $0.65 mn.**

For Univ. of California Lawrence Radiation Lab., Livermore.

Shear and compressional waves were generated and detected in alluvium and to a degree in basalt. The accuracy was 0.5 msec exclusive of the geophone orientation problem. The Mark X Dynagoose seismic source was used to transmit a series of discrete-frequency or monochromatic wavetrains with the data received and processed through narrow-band filters. Separate processed signals were summed with appropriate phasing so that the summation is a signal greatly compressed in time. The frequencies used extend from 50 to 150 Hz with the average frequency being 100 Hz. (F.S.)

26015 (SC-TM–67-253) VIBRATIONAL ANALYSIS OCEAN BOTTOM SEISMIC SYSTEM. **Gladow, D. E. (Sandia Corp., Albuquerque, N. Mex.). Apr. 1967. Contract AT(29-1)-789. 26p. Dep. CFSTI.**

The effect of soft suspension (rubber mounts in a glass sphere and/or mud ocean floors), and a one-degree-of-freedom simplified system which is comparable to a three-point suspension in which one or two points serve as horizontal pivots are evaluated. Response and cross-talk equations are derived for seismometers using LaCoste, swinging gate, and conventional spring-mass suspensions. Analysis of these equations leads to the selection of a system configuration in which cross-talk is minimized. Numerical evaluation indicates that cross-talk from the rubber mounts can be kept as low as "60 db down," but that cross-talk from soft ocean floors may be quite high. The latter effect is presented in plots of maximum cross-talk versus effective spring constant. Short period instruments (1-second natural period) are found to be much more cross-talk sensitive than long period (15-second natural period). (auth)

26016 SEISMIC WAVES FROM HIGH YIELD ATMOSPHERIC EXPLOSIONS. **Tandon, A. N.; Chaudhury, H. M. (Meteorological Office, New Delhi). Indian J. Meteorol. Geophys., 14: 283-301(July 1963).**

Seismic data were for megaton-yield detonations in the USSR from August to December, 1962, were recorded at the Delhi (India) Observatory. Most explosions with yields in the megaton range produced records on Press–Ewing seismographs at Delhi, and a few having yields comparable to that of the largest one on August 5, 1962, and that of October 30, 1961, were also recorded by the ordinary observatory microbarograph. A table gives the arrival times of the important phases recorded on the Delhi seismograms. The distances of the explosions from Delhi, calculated from the S–P time intervals, using the Jeffreys and Bullen travel-time tables are also given. The origin times calculated from these observations and the magnitudes of the earth shocks produced by the explosions are given. P waves could be detected at Delhi for explosions with yields exceeding about 20 Mt. This was recorded only as a single pulse, unlike the situation in earthquakes and underwater explosions, when it is followed by a train of waves. The

S wave was less prominent in these records compared with those in shallow focus earthquakes of equivalent magnitudes, in conformity with the general expectations from compressional source functions. The guided wave Sa was prominently recorded with a speed of travel of 4.45 Km/sec even when the seismic focus was on the surface. M2 waves were well recorded in the range of periods 8 to 15 sec and could also be detected in the higher period range. These waves showed a normal dispersion from 8 to 15 sec, inverse dispersion from 15 to 35 sec, and normal dispersion again at higher periods. The dispersion in the range 8 to 15 sec indicated an average crustal thickness of about 45 Km for the path. Rayleigh waves were well developed and their dispersion could be studied without the interfering influence of other disturbances normally found in earthquakes records. Dispersion studies also gave an average crustal thickness of 45 Km for the path. Rough calculations on the basis of Porkka's dispersion data indicated that the thickness of the crust under the mountain range across the great circle path from Novaya Zemlya to Delhi is 55 to 60 Km. The pressure pulse resulting from the explosions was also recorded by the seismographs. When the yield of the explosion was more than 30 Mt, they were also recorded, at the same time by ordinary observatory microbarographs. A prominent wave group was recorded about 7 min after the arrival of the Rayleigh wave maximum. Though similar arrivals on records of earthquakes are explained as resulting from scattering and reflections from inhomogeneities in the earth's crust, it is suggested this could result from the impact of sound waves on the ground after reflection by the stratosphere. (BBB)

ENGINEERING

Nuclear Explosions

Refer also to abstracts 26069, 26135, 26138, 27032, 27069, and 27070.

26017 (CEX-62.80b) SMALL BOY PROJECT 62.80b AERO-RADIOACTIVITY SURVEY. (Edgerton, Germeshausen and Grier, Inc., Santa Barbara, Calif.). Nov. 1965. Contract AT(29-1)-1183. 19p. (EGG-1183-2060). Dep. CFSTI.

Aerial radiometric surveys conducted during the Small Boy operation are described. The preshot gamma background to a distance of 300 miles from ground zero was determined on four arcs. Postshot operations were started on July 16, 1962 (D + 2 days), and were completed on July 19, 1962. The conterminous fallout pattern was surveyed from 15 to 125 miles from ground zero, and a large area of fallout south and east of Provo, Utah, was located and surveyed. The aerial survey data for these two areas are presented in the form of H + 24-hr ground-dose-rate contour maps, the outermost contour being 0.2 mr/hr. Reconnaissance flights north and east of the Utah area provided additional information on the deposition of Small Boy debris. A detailed aerial survey made in East Indian Springs Valley illustrates the heterogeneity of fallout deposition. The major problems involved in the utilization of aerial gamma counting-rate data are discussed, i.e., those of correcting for radioactive decay and of converting to dose rate. (auth)

26018 (PNE-508) APPARENT-CRATER STUDIES. Final Report. Project PRE-SCHOONER II. Benfer, Richard H. (Army Engineer Nuclear Cratering Group, Livermore, Calif.). Nov. 1966. Contract W-7405-eng-48. 36p. Dep. CFSTI.

Project Pre-SCHOONER II was an 85.5-ton nitromethane detonation conducted by the United States Army Engineer Nuclear Cratering Group as a part of the Joint Atomic Energy Commission-Corps of Engineers nuclear excavation research program. The charge was detonated on 30 September 1965 in hard, dry rhyolite rock at a depth of 71 feet (scaled depth of 142 ft/kt$^{1/3.4}$ based on an energy equivalent yield of 94.1 tons). Surface Ground Zero was located approximately 40 miles southwest of Bruneau, Idaho. Aerial stereophotogrammetric mapping and conventional field survey techniques were used to determine the apparent-crater measurements of the Pre-Schooner II detonation. The apparent-crater radius of 95.2 feet and depth of 60.7 feet are much larger than the values predicted using the basalt cratering curves (scaling power 1/3.4). The apparent crater has a volume of 24,780 yd^3 and the average profile is approximately hyperbolic. (auth)

26019 (PNE-720F) GEOLOGIC AND ENGINEERING PROPERTIES INVESTIGATIONS. Project SULKY. Final Report. Lutton, R. J.; Girucky, F. E. (Waterways Experiment Station, Vicksburg, Miss.). Sept. 1966. 131p. Dep. CFSTI.

The Sulky event was a nuclear cratering experiment in which a device yielding 85 ± 15 tons was detonated at a depth of 90 feet in jointed basalt. The explosion produced a rubble-covered mound roughly circular in plan and extending approximately 24 feet above the original ground surface. Prior to the event the Sulky site was explored by means of six core borings and the emplacement calyx hole. Geophysical logging was conducted and laboratory tests were performed on representative samples. Postshot investigations consisted of trenching through the mound and drilling three core borings to determine the extent of the rupture zone. The rock consists of vesicular basalt over dense basalt and each type is structurally modified by layering of vesicles resulting from viscous flow of the lava. Unconfined compressive strengths range from about 10,000 psi for vesicular basalt to about 20,000 psi for dense basalt. Bulk specific gravities for dense basalt are about 2.74, but with increasing vesicle content the bulk specific gravity reaches values as low as 2.40. Two sets of axes of folds developed during flow of the lava are inferred from flow layer orientation. Subsequent natural joints tend to be parallel or perpendicular to this primary anisotropy and an orthogonal joint pattern emerges for most of the site. This natural pattern influenced the orientation of blast fractures, the orientation of surface fissures, the shape of the crater, and the distribution of rubble (ejecta and fallback) sizes. The gross subsurface effect of the blast was development of a camouflet about 60 feet in diameter surrounded by a ruptured and dilated zone averaging about 200 feet in diameter. The limit of the dilated zone flares near the surface and in the center a chimney of the expanded media is inferred to have subsided and partially filled the camouflet. (auth)

26020 MARGUERITE, A RADIOISOTOPE MARITIME GENERATOR. Stoll, R. (CSF, Puteaux, France); Freund, J. pp 425-9 of Industrial Applications for Isotopic Power Generators. Paris, European Nuclear Energy Agency, 1967. (In French).

A generator prototype using radioisotopes and thermoelectric conversion of low power was developed. This type generator is used as the source of electric power for maritime detection devices. The principal characteristics of Marguerite are tabulated. (tr-auth)

Facilities and Equipment

26021 (ANL-7277) TWO AXISYMMETRIC STEADY-STATE THERMOELASTICITY PROBLEMS FOR TRANSVERSELY ISOTROPIC SOLIDS. Valentin, Richard A. (Argonne National Lab., Ill.). Dec. 1966. Contract W-31-109-eng-38. 35p. Dep. CFSTI.

In connection with a study of the possible utility of anisotropic elastic models in the representation of the internal structure of certain reactor fuel elements, two sample problems are considered to aid in evaluating the analytical and numerical difficulties associated with the introduction of anisotropic effects. Treated are the stress fields associated with a thermal inclusion in the form of a half-infinite circular cylinder in a transversely isotropic space and a traction free, infinite, transversely isotropic, circular cylinder having a particular discontinuous axial surface temperature. Both the isotropic and anisotropic cases are analyzed by means of the stress function formulation of A. Singh. Numerical evaluation of representative stresses are presented for the isotropic case and for a typical transversely isotropic material (magnesium). (auth)

26022 (AWRE-O-32/67) PRODUCTION OF NUCLEAR TARGETS BY VACUUM EVAPORATION. Arnison, G. T. J. (Atomic Weapons Research Establishment, Aldermaston (England)). May 1967. 42p. Dep. CFSTI. UK 9s. 0d.

A survey is given of current methods and specialised techniques for producing thin film nuclear targets by vacuum evaporation. (auth)

26023 (EUR-3285.f) EVOLUTION DU TRANSPORT OCEANIQUE DE CONTAINERS PAR DES CARGOS RAPIDES, CONDUISANT A DE MEILLEURES PERSPECTIVES POUR L'UTILISATION DE LA PROPULSION NUCLEAIRE. (Development of Ocean Transport of Containers in Fast Cargo Ships, Leading to Better Prospects for the Adoption of Nuclear Propulsion). Boos, H. (European Atomic Energy Community). Mar. 1967. 52p. (In French). Dep.

Container ships made their appearance on the North Atlantic routes in 1966 and the amount of containerized cargo shipped through the major ports of the world is growing at an increasing rate. The enormous reduction in the annual number of days spent in port allows the container ship to be operated at considerably higher economic speeds than have previously been profitable for the breakbulk cargo ship. To attain these speeds unusually powerful propulsion plants must be installed. The nuclear marine installation is economically superior to a fossil-fueled one at high power levels and in combination with a high utilization factor. Fast container ships are therefore likely to be the first vessels for which the marine reactor will be adopted on a purely commercial basis. (auth)

26024 (INR-757/XI/R) POCZTA PNEUMATYCZNA KROTKICH AKTYWACJI. (The Pneumatic System for Short Activations). Post, R.; Dziakowski, E.; Matysiak, T. (Institute of Nuclear Research, Warsaw (Poland)). Oct. 1966. 30p. (In Polish). Dep.

A pneumatic activation system operating in a vacuum of about 1100 mm H_2O connects the 45 mm dia channel of a research EWA reactor and the 9.9×10^{12} n/cm sec^{-1} thermal neutron flux with the spectrometric laboratory and the station of short irradiation. Externally, the channel is cooled by the primary circuit water. The transportation of the plastic container from the reactor to the spectroscopy station over the distance of 21 m takes 3 sec and to the station of short irradiation, a distance of over 53 m, takes 7 sec. The protective effects of the shielding at both ends of the station are limited to the container activity not exceeding 100 μC (^{60}Co). (tr-auth)

26025 (ORNL-TM-1560) ORMEF: A FORTRAN CODE FOR COMPUTING DETAIL MULTI-EFFECT MULTI-STAGE FLASH EVAPORATION DESALINATION PLANT DESIGNS. Mothershed, C. T. (Oak Ridge National Lab., Tenn.). Aug. 1966. Contract W-7405-eng-26. 128p. Dep. CFSTI.

A program written for the IBM-7090 computer performs design calculations for the Oak Ridge Multi-Effect Flash (ORMEF) desalination plant. Designs can be computed for plants having between 1 and 25 effects, with each effect having a maximum of 99 stages. The output of the code gives the process parameters, costs, geometry, and other design information of interest. (auth)

26026 (SCL-TN-67-31) RELUCTANCE OF A TOROIDAL COIL WITH A RECTANGULAR CROSS-SECTIONAL AREA. Kalata, P. R. (Sandia Corp., Livermore, Calif.). Apr. 1967. Contract AT(29-1)-789. 2p. Dep. CFSTI.

A study of magnetic circuits emerged is described. The reluctance of a circuit is a function of the geometric configuration of the coil and the magnetic properties of the material. Assuming that the magnetic properties of a material are linear; i.e., μ is a constant, method calculate reluctance of a rectangular toroidal coil was sought. The following derivation may be of academic interest. The derivation and calculus used is straightforward. The derivative was found using the general form of reluctance and the equivalent value for parallel paths. It was then integrated to give a closed form for such a coil. A computer verification of this derivation has been developed and is presented. (R.C.K.)

26027 (TID-4100(Suppl.31)) SUPPLEMENTAL INSERT SHEETS FOR ENGINEERING MATERIALS LIST. Duthie, Richard E. C. (ed.). (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). Dec. 1965. 58p. Dep. DTIE Free.

Supplementary insert sheets are presented for 6 packages of engineering drawings. These sheets should be inserted in the proper numerical CAPE-numbered sequence in TID-4100. The drawings describe the service machine, the charge machine, the facility buildings, the reactor buildings, and modular reactor instruments for the Experimental Gas Cooled Reactor. (F.S.)

26028 (UCRL-50108(Vol.2)) COMPENDIUM OF SHOCK WAVE DATA. Sections B, C, D, Index. van Thiel, M. (ed.) (California Univ., Livermore. Lawrence Radiation Lab.). June 1966. Contract W-7405-eng-48. 322p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Tables and graphs are presented which give the thermodynamic data for condensed media obtained by shock wave techniques. Both dynamic variables and volumetric quantities associated with the shock wave are given. Media covered include hydrocarbons and other organic compounds, alloys, solutions, and mixtures. Information on the elements and compounds is contained in Vol. I. See NSA 21: 5848 for abstract of this volume. (F.S.)

26029 (Y-1579) AUTOMATIC TOOL SETTING FOR NUMERICALLY CONTROLLED MACHINES. Reedy, K. B. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). May 22, 1967. Contract W-7405-eng-26. 25p. Dep. CFSTI.

An automatic tool-setting system was designed and installed on a Heald turning machine which was equipped with a Bendix Dynapath numerical control unit. Tape commands initiate an independent tool-setting cycle which automatically positions the machine slides to a fixed reference point relative to the datum and pole planes of the workpiece. When the tool-setting cycle is complete, control of the machine is returned to tape direction and the normal cutting cycle continues. Greater consistency of produced parts, increased accuracy, and reduced machining time per part are major advantages of this automatic tool-setting system. (auth)

26030 (ORNL-tr-1608) THE STATE AND DISTRIBUTION, MONITORING, AND ELIMINATION OF IMPURITIES IN CIRCULATING ALKALI METAL COOLANTS. Leipunskii, A. I.; Subbotin, V. I.; Ivanovskii, M. N. Translated for Oak Ridge National Lab., Tenn., from a paper presented at the IAEA Symposium on Alkali Metal Coolants, Corrosion Studies, and System Operating Experience, Vienna, November 29–December 2, 1966. 30p. (CONF-661110-33). Dep. mn. CFSTI $3.00 cy, $0.65 mn. JCL $2.60 fs, $1.10 mf.

In developing equipment for liquid metal coolant monitoring, sampling, and purification, it is necessary to know the form in which a given impurity is present and the laws of its distribution. Types, sources, states, and distribution of impurities in liquid metal coolants are discussed. The most promising methods of monitoring impurities are activation, concentration cells, internal tracers, thermoelectric power, membrane diffusion, and electrical resistance. Purification of a circulating coolant is mainly done with hot or cold traps. Diffusion cold traps for efficient purification and removal of oxygen, hydrogen, and corrosion and erosion products are discussed. (F.S.)

26031 REACTOR ELECTRICAL EQUIPMENT. Long, E.; Quarmby, R. B. (English Electric Co., Whetstone, Eng.). Elec. Rev. (London), 180: 168-71(Feb. 3, 1967).

The application of the principles of reliability, safety, and systems engineering to the design of equipment is reviewed, and the scope for its use outside the reactor field is suggested. Examples of equipment include control and safety systems, electromechanical and electromagnetic pumps, electrically operated valves, and refueling systems. (UK)

26032 ENGINEERING FOR COMMUNITY ACCEPTANCE. Proc. Amer. Power Conf., 28: 293-317(1966).

The current AEC regulations for the control of radiation hazards in the nuclear industry are outlined. The procedure for the licensing of nuclear power plants requires two stages of review and evolution. The first of these is the construction permit stage and the second is the operating license stage. It is stressed that the nuclear industry is becoming increasingly imaginative and resourceful in advances in design and in organization and management of operations. (R.C.K.)

26033 THE LABORATORY OF RADIOMETALLURGY OF FONTENAY-AUX-ROSES. Valentin, A.; Faugere, J. L. Bull. Inform. Sci. Tech. (Paris), No. 113, 3-33(Mar. 1967). (In French).

The construction and the equipment of a radiometallurgy laboratory at Fontenay-aux-Roses, where irradiated plutonium fuels, either prototypes or taken from French fast reactors, will be studied are described. The laboratory has a ground floor area of 2200 m^2 and contains twelve cells having a total "hot" working area of 117 m^2. It has two types of α β γ cells: one where an α tight box (2m 2m × 1.3m) equipped with two magnetic 6 kg capacity manipulators is placed in a β γ enclosure (machining and metallographic cells); and another where the inside surface of the β γ walls are lined with an α tight skin (research cells). Sealed model A manipulators are used. The β γ front wall has thickness of 1.05 m and is made with 3.5 density heavy concrete. The building facility support systems, and the equipment of the α β γ hot cells are described. (tr-auth)

26034 CENTRIFUGAL AND AXIAL FLOW PUMPS. THEORY, DESIGN, AND APPLICATION. SECOND EDITION. Stepanoff, A. J. New York, John Wiley and Sons, 1967. 468p. $12.50.

The theory, design, and applications of centrifugal and axial flow pumps are presented. Special problems encountered in pump design, application, and operation are discussed. Shaft design for critical speeds is also described. (R.C.K.)

26035 INTERKAMA 1965. VORTRAEGE ZUM INTERNATIONALEN KONGRESS MIT AUSSTELLUNG FUER MESSTECHNIK UND AUTOMATIK, DUESSELDORF, 13. BIS 19. OKTOBER 1965. (Interkama 1965. Reports to the International Congress with Exhibition for Measurement Techniques and Automation, Duesseldorf, Oct. 13 to 19, 1965). Munich, R. Oldenbourg Verlag, 1966. 225p. (CONF-651083).

A compilation is presented of the 71 papers given at the International Congress. With the exception of the seven invited papers, all contributions have appeared in journals. The topics considered were measurement techniques for the protection of man, automation in power plants, automation and remote control technology in electrical production nets, investigation of raw materials and semifinished and completed articles in industry, automatic measurement devices for testing and control, new applications in the measurement of nonelectrical quantities, correlation methods in measurement and control technology, electron digital techniques in measurement and control, pneumatic digital techniques in measurement and control, registration and storage of measurement data, automation in manufacture, oscillation measurement technology in manufacture, operational reliability of devices, and plant safety. Five papers have appeared previously in NSA. For abstracts of these see abstract numbers 20: 12730, 16926, 28471, 34914, and 45580. (J.S.R.)

26036 ELECTRONS, NEUTRONS, AND PROTONS IN ENGINEERING. A Study of Engineering Materials and Processes Whose Characteristics May Be Explained by Considering the Behavior of Small Particles When Grouped Into Systems Such as Nuclei, Atoms, Gases, and Crystals. Eaton, J. R. International Series of Monographs on Interdisciplinary and Advanced Topics in Science and Engineering. Volume 2. New York, Pergamon Press, 1966. 556p.

A study of engineering materials and processes whose characteristics may be explained by considering the behavior of small particles when grouped as nuclei, atoms, gases, and crystals is presented. The basic phenomena associated with the mechanical, thermal, and electrical properties of gases and solids, dielectric and magnetic properties of solids, behavior at surfaces, radiation measurements and effects and heat production in the fission process are described. (R.C.K.)

26037 QUEHANNA PILOT PLANT CELL 4 (Engineering Materials). (Martin Co., Denver). (CAPE-1575).

73 drawings

Cell 4 of the Quehanna Radioisotope Pilot Plant is described. The Pilot Plant is used in processing ^{90}Sr for loading in SNAP thermoelectric generators. A processing box, which is located in cell 4 is designed to receive $Sr(NO_3)_2$ and to produce an encapsulated heat source, is divided into chambers A and B. Chamber A provides primary containment protection for primary heat source encapsulation and initial fuel container decontamination. Chamber B provides primary contamination protection for final decontamination of the first encapsulation. Cell structure, the stationary overhead transfer system (SOTS), the ventilation system, the bridge-hoist, powder handling equipment, storage compartments, and a shipping cask are described. (For details see TID-4100 Suppl. 40). (F.S.)

26038 CONTINUOUS CALCINER (Engineering Materials). (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). (CAPE-1577).
37 drawings

Calciners are described which are used to continuously convert UNH from both normal, depleted, and slightly enriched U into UO_3 in large-scale production. The calciners consist of a covered heated trough ~20 ft long into which UNH is introduced. Revolving agitators push the material to one end where it is continuously withdrawn from the calciner for hammer milling to the proper fineness for storage and shipment. The calciners include provisions for recovery of nitric acid with auxiliary equipment to reduce the acid to 60% concentration. The assembly is automatically operated and six calciners can be operated by one attendant. (For details see TID-4100 Suppl. 40). (F.S.)

26039 DRY GLOVE BOX RETAINING MEANS. Boddy, Lawrence O. (to U. S. Atomic Energy Commission). U. S. Patent 3,323,846. June 6, 1967.

A plastic sealing band for a dry box glove port is described. The continuous band fits the inner circumference of the ring defining the glove port and seals the glove to the port. A recessed surface on the outer circumference of the band facilitates the engagement of a tool used in removing the band from the glove port. (AEC)

26040 REACTION VESSEL FOR PRODUCTION OF PLUTONIUM. Conner, William V. (to U. S. Atomic Energy Commission). U. S. Patent 3,328,017. June 27, 1967.

A reaction vessel is described, which may be used in the chemical reduction of metals. The vessel has a reuseable liner of material such as graphite disposed in an annular space between an outer pressure vessel and an inner crucible of refractory material. (AEC)

Heat Transfer and Fluid Flow

Refer also to abstract 26028.

26041 (AAEC/TM-354) A METHOD FOR MEASURING THE FLUID FLOW DISTRIBUTION AT EXIT FROM A RIGHT CYLINDRICAL, RANDOMLY PACKED BED. Price, J.; Stevens, J. R. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Oct. 1966. 21p. Dep.

A method for measuring the fluid flow distribution at exit from a right cylindrical, randomly packed bed of spheres has been investigated using a flow separator to prevent redistribution of the flow between the exit face of the bed and the plane of measurement. Three designs of separator were tested, for each of which steady fluid velocities were measured with a pitot static tube in the exit plane of the separator, and unsteady velocities with a hot wire anemometer. A separator with contracting flow passages was developed which facilitated measurement and reduced turbulence intensities without causing any significant flow redistribution within the bed. Measurements are presented for a loosely packed bed of glass spheres which show that the velocity profile is reasonably uniform over the bed except for a region within a half sphere diameter of the vessel wall. This differs substantially from the profiles measured by most previous investigators. (auth)

26042 (AEEW-M-725) AN INVESTIGATION INTO A POSSIBLE MECHANISM OF SUBCOOLED BURNOUT. Kirby, G. J.; Staniforth, R.; Kinneir, J. H. (Atomic Energy Establishment, Winfrith (England)). Mar. 10, 1966. 14p. Dep. CFSTI.

Recent investigations into the cause of burnout have shown that in the quality regime film dry-up is the dominant mechanism, whereas subcooled burnout results from local blanketting of the heater by a steam bubble. Visual experiments performed at 25 psia showed that, near zero quality, large bubbles form which press close to the heated surface, leaving only a thin liquid film to cool the heater. By measuring the film thickness between bubbles and heater it has been shown that dry-up of the liquid is not the cause of forced-convection subcooled burnout in water under these conditions. (UK)

26043 (AEEW-R-463) A CORRELATION OF BURNOUT DATA FOR UNIFORMLY HEATED ANNULI AND ITS USE FOR PREDICTING BURNOUT IN UNIFORMLY HEATED ROD BUNDLES. Barnett, P. G. (Atomic Energy Establishment, Winfrith (England)). Sept. 1966. 104p. Dep. CFSTI. HMSO 13s. 6d.

A correlation is presented of burnout heat flux data for water under forced convection through annuli having the rod uniformly heated and the shroud tube unheated. Only one inlet pressure, 1000 psia, is considered and for the 724 reliable experimental results at this pressure the rms error of the correlation is 5.9%. It is shown that, using a heated equivalent diameter concept, the correlation may be used to predict accurately the occurrence of burnout in a wide variety of uniformly heated rod bundles. (auth)

26044 (BMwF-FBK-67-05) DRUCKABFALL UND WAERMEUEBERGANG BEI DER LAMINAREN UND TURBULENTEN ROHRSTROEMUNG VON QUECKSILBER. (Pressure Drop and Heat Transfer in Laminar and Turbulent Tube Flow of Mercury). Tratz, H. (Technische Hochschule, Munich (West Germany). Institut fuer Technische Thermodynamik). Jan. 1967. 94p. (In German). Dep.

Abnormalities in the hydrodynamic and thermal behavior of liquid metals prompted this work. For the investigation of pressure drop and heat transfer an apparatus was developed which allowed measurements without any conceivable perturbations. The results of these measurements are in such good agreement with theoretical predictions that it can be stated that hydrodynamic and thermal behavior of pure mercury along pure steel walls is that of a normal liquid. The influence of argon dissolved in the mercury or adsorbed at the tube wall is small. These definite principles are obtained for the calculation of liquid metal cycles which are used in nuclear and astronautic applications. (tr-auth)

26045 (BNWL-371(Pt.1)) CROSS-FLOW MIXING BETWEEN PARALLEL FLOW CHANNELS DURING BOILING. PART I. COBRA: COMPUTER PROGRAM FOR COOLANT BOILING IN ROD ARRAYS. Rowe, D. S. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar. 1967. Contract AT-(45-1)-1830. 112p. Dep. CFSTI.

A mathematical model and digital computer program for computing coolant flow and enthalpy in the subchannels of rod bundle fuel elements is presented. One dimensional, two-phase, slip flow in the subchannels provides the basis for the mathematical model. The model also includes the effect of mixing that occurs through the gap between adjacent subchannels by using a turbulent (fluctuating) cross-flow and a diversion cross-flow that results from flow redistribution. The digital computer program COBRA solves the mathematical equations by using numerical procedures similar to the modified Euler method, but with an additional feature to control diversion cross-flow and insure a stable solution. COBRA considers both single and two-phase flow in rod bundles of arbitrary geometry and can consider up to 36 subchannels and 25 fuel rods. Arbitrary heat flux distributions are specified by the axial flux distribution, relative rod power and fraction of rod power to each adjacent subchannel. (auth)

26046 (IFA-TR-52) EKSPERIMENTAL'NOE ISSLEDOVANIE GIDRODINAMIKI DVUKHFAZNYKH POTOKOV V VERTIKAL'NYKH TRUBAKH. (Experimental Studies of Hydrodynamics of Two-Phase Flow in Vertical Tubes). Bartolomei, G. G.; Georgescu, R. (Academia R. P. R., Bucharest. Institutul de Fizica Atomica). 1966. 26p. (In Russian). Dep. mn.

New experimental data are given for the determination of φ for water flowing in vertical unheated tubes at pressures of 15, 25, and 35 bar at 0.06 to 1.3 m/sec and for steam at 0.2 to 3 m/sec. The data are expressed by the formula $\varphi = W_0''/(W_0'' + W_0' + a)$, where $a = 0.65 - 0.0039P)(d/63)^{0.20}$. There was satisfactory agreement between the formula and experimental data. For pressures of 25 and 35 bar the difference is 5 to 8%; at 15 bar, 30%. The flow regime of steam-water mixtures in pipes of small diameter with and without heating was investigated for pressures of 15, 25, and 35 bar. (C.E.S.)

26047 (KFK-512) EXPERIMENTELLE UNTERSUCHUNGEN AN NATRIUM-GEFUELLTEN HEAT PIPES. (Experimental Investigations on Sodium-Filled Heat Pipes). Dorner, S.; Reiss, F.; Schretzmann, K. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). Jan. 1967. 21p. (In German). Dep.

The possibilities of producing heat pipes and, especially, the necessary capillary structures are discussed. Several types of heat pipes are made from stainless steel and tested at temperatures between 400 and 1055°C. The thermal power was determined by a calorimeter. Bubble-free evaporation of sodium from rectangular open channels is possible with a heat flux of more than 1,940 W/cm² at 1055°C. The temperature drop along the tube could be measured only at low temperatures. A subdivided heat pipe worked against the gravitational field. A heat pipe with a capillary structure made of a rolled screen supported by rings and bars operated at 250 W/cm^2 heat flux in the evaporating region. (tr-auth)

26048 (NAA-SR-8508) DESIGN, PERFORMANCE, AND ECONOMICS EVALUATION OF SODIUM-HEATED, MODULAR, SUPERCRITICAL, STEAM GENERATORS. Casey, D. F. (ed.) (Atomics International, Canoga Park, Calif.). Oct. 31, 1966. Contract AT(11-1)-Gen-8. 71p. Dep. CFSTI.

An IBM 7090 digital computer heat transfer code for a supercritical, once-through, sodium-heated, steam generator was developed. A water-side fouling factor was determined, based on published data. Detail designs of 37-tube and 61-tube modular steam generators were completed. Designs showing the installation of the modules, including their interconnecting piping, supporting structures, etc., were completed and price estimates obtained. A re-evaluation of previous economic studies continued to indicate cost savings resulting from the use of supercritical steam conditions. Three other reports cover the development and test phase of the project. One pertains to the welding development, NAA-SR-8541; and the others, NAA-SR-8414 and NAA-SR-8415, pertain to the experimental stress programs. (auth)

26049 (NASA-TN-D-3943) ASSESSMENT OF CONVECTION, CONDUCTION, AND EVAPORATION IN NUCLEATE BOILING. Graham, Robert W.; Hendricks, Robert C. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). May 1967. 46p. CFSTI.

Various heat transfer mechanisms including convection, transient conduction, and evaporation are discussed and evaluated as to their contribution to the overall nucleate boiling heat flux. Recent boiling experiments that pertain to these mechanisms are cited. From the evaluation, a nucleate boiling model is proposed that includes elements of each of the aforementioned mechanisms. A model was compared with experimental information on water and methanol; no single mechanism dominates over the entire boiling heat flux range. It is true, however, that evaporation becomes the chief contributor for heat fluxes that are greater than 20 percent of the critical value. Transient conduction is an important contributor to the total heat flux over a broad range of conditions. The cyclic removal of heat from the surface into the liquid sublayer by conduction appears to be an efficient process compared with steady-state free convection. The repeated destruction of the thermal layer that ensues the departure of a bubble enables this transient conduction process to be repeated at a bubble site. The overall model presented herein emphasizes that nucleate boiling should be thought of primarily as a series of transient heat transfer processes going on over distinct regions of the surface. (auth)

26050 (UCRL-17324) ON THE MECHANISM OF ELECTROLYTIC GAS EVOLUTION. Cheh, Huk Yuk (California Univ., Berkeley. Lawrence Radiation Lab.). Feb. 1967. Contract W-7405-eng-48. 111p. Dep. CFSTI.

Thesis.

A review on the various steps involved in the formation of a gas phase at an electrode-solution interface and on the mass transfer aspects associated with the overall process is presented. The analogies between electrolytic gas evolution and nucleate boiling are also discussed. Theoretical calculations on the dynamics of asymptotic bubble growth in an initially nonuniform concentration or temperature field are performed. For the case of electrolytic gas evolution, a significant simplification is achieved by noting that the Jakob number for mass transfer is usually small so that the convective transport can be neglected in comparison with the diffusive transport. Numerical solutions are obtained for the growth rate of a hemispherical bubble on an electrode surface with linear and exponential initial concentration fields of the electrolytically generated gas and also for the cases involving initial concentration fields resulting from the constant potential and constant current experiments. For the case of nucleate boiling, the parametric solution of Skinner and Bankoff using the thin thermal boundary layer approximation associated with the large Jakob number for heat transfer is applied to obtain numerical solutions for the cases of constant potential and constant current. Theoretical calculations for fluid flow and for mass transfer to rising bubbles or drops at both large Re and large Pe numbers are performed using the boundary layer approach of Levich. Satisfactory agreement is obtained when comparison is made to available experimental data. Possible extensions for future investigations are outlined. (auth)

26051 CONTRIBUTION TO THE PROBLEM OF VAPOR PHASE STUDIES IN BOILING LIQUID METALS. Schelten-Peterssen, B.; Schulze, W.; Grass, G. (EURATOM, Ispra, Italy). Atomkernenergie, 12: 15-19(Jan.-Feb. 1967). (In German).

A new method of detecting vapor bubbles in liquid metals is described. This method makes it possible to detect and to observe the behavior of single vapor bubbles or groups of them. The principle used is that of ultrasonic absorption. The ultrasonic apparatus used as well as the measuring and calibration instruments are described. It appears from the results that the measuring principle may be applied. (tr-auth)

26052 CONDUCTIVITY PROBE FOR MEASURING LOCAL VOID FRACTIONS IN TWO-PHASE FLOW. Lafferty, J. F.; Hammitt, Frederick G. (Univ. of Michigan, Ann Arbor). Nucl. Appl., 3: 317-23(May 1967).

An electric conductivity probe, which provides a means of accurately measuring local void fractions in two-phase flow, was developed. The void fractions obtained with the probe in an air-water mixture agreed with those calculated from flow rate data to within about ±25% of the calculated value. However, an empirical modification of the current-void relationship brought this agreement to within ±8% for void fractions ranging from 0.19 to 0.77. (auth)

26053 HEAT TRANSFER AND PRESSURE DROP IN INSIDE HEATED ANNULI BY HIGH PRESSURE GAS COOLING. Presser, K. H.; Pietralla, G.; Harth, R. (Kernforschungsanlage, Juelich, Ger.). Atomkernenergie, 12: 43-54(Jan.-Feb. 1967). (In German).

Heat transfer and pressure drop of three different annuli with diameter ratios of 1.5, 2.0, and 2.67 were investigated with turbulent flow of CO_2 and N_2. These measurements were conducted at pressures from 10 to 80 kp/cm^2 and gas temperatures from 200 to 400°C. Reynolds numbers (Re) were in the range from 70,000 to 5,000,000. The physical properties of thermal conductivity, viscosity, specific heat, and density were evaluated for variable conditions of flow mixture temperatures and tube wall temperatures. Heat transfer and friction coefficient determinations were mathematically correlated to the empirically measured gas flow variables. In the investigated range of Re from 70,000 to 5,000,000, the Nusselt number was found to increase as a function of $Re^{0.88}$, whereas in the Re range of 10,000 to 100,000 this increase is proportional to $Re^{0.80}$. Heat transfer and pressure drop increase slightly with increasing diameter ratio. (L.C.L.)

26054 NON-HYDRODYNAMIC ASPECTS OF POOL BOILING BURNOUT. Tachibana, Fujio; Akiyama, Mamoru; Kawamura, Hiroshi (Tokyo Univ.). J. Nucl. Sci. Technol. (Tokyo), 4: 121-30(Mar. 1967).

More than 400 pieces of test sections—flat plates made of various metals and alloys—were placed in saturated water under atmospheric pressure and heated to physical destruction by passing electric current directly through them. Several nonhydrodynamic parameters have marked effect upon the critical heat flux, which indicates that purely hydrodynamic theories are not directly applicable to general prediction of the critical heat flux. The critical heat flux data were found to be well correlated with the heat capacity per unit surface area of the test section: the critical heat flux is reduced with decrease of this parameter, while with increasing parameter it approaches a certain asymptotic value. The fluctuation of surface temperature due to alternate contact with vapor and liquid was calculated by the proposed model, and the trend of dry-out duration was estimated from the critical heat flux data. (auth)

26055 NEW MICROPOROUS THERMAL INSULATION. McWilliams, J. A.; Hughes, J. (Spectar Engineering, Kidderminster, Eng.). pp 363-75 of Industrial Applications for Isotopic Power Generators. Paris, European Nuclear Energy Agency, 1967.

The development of a new microporous thermal insulation called MICROTHERM is described. This insulation has very low thermal conductivity values in air—less than those of still air itself, up to a temperature of 1100°C. It is based on the application of the microporous principle in which a structure having cellular pores of sizes less than the mean free path of air (approx. 0.7μ) inhibits the normal molecule/molecule collision thermal conduction process in a gas. A combination of microporous material, opacifiers and ceramic fibres is used to produce blocks and moldings which can be readily machined, or, incorporated into flexible blankets or steel clad structures. (auth)

26056 EXPERIMENTAL INVESTIGATION OF VELOCITY DISTRIBUTION AND FLOW RESISTANCE IN A TRIANGULAR ARRAY OF PARALLEL RODS. Eifler, W.; Nijsing, R. (EURATOM, Ispra, Italy). Nucl. Eng. Design, 5: 22-42(Jan.-Feb. 1967).

The determination of velocity distribution and flow resistance for fully developed turbulent flow parallel to a triangular array of rods is described. The effects of Reynolds number and rod spacing were investigated. The results obtained appear to agree satisfactorily with theoretical predictions. (auth)

26057 DEVICE FOR THE STUDY OF BUBBLE FLOW WITHIN A PIPE. Chevalier, Henri; Lakme, Claude; Max, Jacques (to Commissariat a l'Energie Atomique). British Patent 1,069,336. May 17, 1967. Priority date Aug. 27, 1964, France.

The device consists of two very thin probes with sensitive tips disposed along a vertical line within a pipe in which the bubble flow is to be studied. Each probe is designed to produce an electric pulse when reached by a bubble as a result of variation in resistance of the electric circuit in which the probe is connected. The pulses produced by the probe are transmitted by an amplifier and a shaping unit to delay devices, which are associated in series, and their outputs are coupled to one of the inputs of coincidence circuits. The outputs of the coincidence circuits are connected, respectively, to a corresponding number of counters. The pulses derived from the other probe, the last to be reached by the bubbles, are transmitted by means of identical circuitry to the second coincidence circuits. (B.L.M.)

26058 BODIES WITH FINNED HEAT TRANSFER SURFACES. Eltham, Barry Edward (to United Kingdom Atomic Energy Authority). British Patent 1,069,251. May 17, 1967. Filed June 6, 1963.

A heat transfer surface suitable for use on sheaths of nuclear fuel elements has a finned pattern involving lengths of finning each initially secured at both ends of the length as well as at the root. The fins are slit with one or more narrow cuts so as to relieve straining of the fins with temperature change of the body and thus to avoid fin deformation by random curving. (B.L.M.)

26059 IMPROVEMENTS IN AND RELATING TO HEAT TRANSFER TUBES. (to Sulzer Brothers Ltd.). British Patent 1,068,964. May 17, 1967. Priority date Sept. 6, 1963, Switzerland.

A heat transfer tube is provided with longitudinally extending fins angularly spaced to provide longitudinal flow channels for the flow of heat exchange medium along the channels between the fins. The fins are interrupted by at least one generally spiral channel, which has an angle of inclination to the longitudinal axis of the tube of between 5 and 20° and intersects the longitudinal flow channels. (B.L.M.)

26060 APPARATUS FOR MEASURING HEAT FLOW. Berger, Jacques (to Commissariat a l'Energie Atomique). British Patent 1,068,572. May 10, 1967. Priority date June 26, 1963, France.

An apparatus for measuring heat flow is described for particular application to the measurement of heat flow released by a sample on irradiation. The apparatus includes an inner cylindrical metal envelope in which the sample to be tested or a heat producing standard for calibration purposes is removably located. This envelope is provided with an electrical conductor on and in thermal contact with the outer surface of the envelope. Another envelope serving as a protective envelope is provided externally and coaxially with the inner envelope. A medium of constant thermal conductivity is interposed in the sealed cavity formed between the two envelopes. (B.L.M.)

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Refer also to abstracts 26037, 26055, and 26272.

26061 (EUR-3128,f) ETUDE SUR L'APPLICATION DES TRACEURS ACTIVABLES. (Study of the Application of Tracers). Bondy, C. (Atome Industriel, Chatillon-sous-Bagneux (France)). Sept. 1966. Contract 029-64-7 IRAF. 124p. (In French). DTIE.

A study on activable tracers containing a collection of bibliographical and theoretical data and a report on experiments based on these data is presented. The list of reference works on uses already made of activable tracers is, in principle, complete up to 1 May 1965. A table of theoretical and experimental values on the activation of elements that can be used as tracers enables the searcher to select one or more tracers that may provide the key to his problem. A theoretical review of highly diluted solutions and a number of experiments on the uptake and ageing of tracers provide examples of the tests to be applied to each of the theoretically suitable tracer substances. A bibliographical and theoretical study shows how a liquid phase can be labelled in the presence of its vapour. Examples contribute a mathematical basis from which to predict and interpret each experiment on the true scale. A section on methods of utilizing activable tracers concludes the work. (tr-auth)

26062 (EUR-3169,f) ETUDE SUR L'UTILISATION DES RADIOISOTOPES POUR LE MARQUAGE DES MATERIAUX REFRACTAIRES UTILISES EN FONDERIE. (Study of the Use of Radioisotopes for Labeling Refractory Material Used in Foundry). Descamps, Cl.; Delporte, E. (Societe Belge pour l'Industrie Nucleaire, Brussels); Berger, R.; Nicolaides, P.; Jassogne, L. (Usines Emile Henricot, S. A., Court-St.-Etienne (Belgium)). Nov. 1966. Contract 011-62-12 IRAB. 120p. (In French). Dep.

The development of practical methods to be used by metal-casters for control and detection of exogenic inclusions in castings without demolishing them, in opposition with other methods is described. As to the type of casting accessory, two labeling methods were used, both utilizing zirconium-95 as a tracer. For the casting accessories in moulding sand a "dry" method has been used, consisting of mechanically mixing with sand, zircon previously irradiated in a reactor. For casting accesories in the form of well determined refractory pieces, a "wet" method was used to introduce the tracer into those elements. The tracer, in the form of a zirconium nitrate solution, is sprayed on the refractory by means of an apparatus especially conceived for this purpose. The pieces undergo a thermal treatment transforming the zirconium nitrate into oxide. Different metallic pieces were cast by means of those labeled accessories. The inclusions have been detected without difficulty by passing a scintillator over the pieces. The two methods proved very practical in use and the sensitivity of detection permits an easy locating of inclusions from about 15 mg, inserted in 3 mm thick steel. (tr-auth)

26063 (ISO-SA-40) ECONOMIC ASPECTS OF CESIUM MIXTURES FOR LARGE IRRADIATION SOURCES. Cochran, J. S.; Cunningham, G. E. (Isochem Inc., Richland, Wash.). Apr. 24, 1967. 16p.

The use of large irradiators for the industrial processing of a variety of products is on the increase. Since many of these industrial processes are subject to potential rapid obsolescense, it is extremely important that the capital cost of the irradiator plant, including the irradiation source, be kept to a minimum, particularly during the early stages of operation. If one takes advantage of relatively short-aged material, fission product cesium offers reduced capital requirements and low operating cost, together with potential long-term advantages. The Curie ratios of cesium-134 to cesium-137, the gamma energies, decay rates, beta heat generation rate, and comparative costs are discussed for cesium recovered from fuel irradiated to 25,000 megawatt days per ton in a pressurized water power reactor. This case assumes that the mixture of cesium is separated and used one year after reactor discharge. The chemical form was assumed to be cesium chloride in 316 low-carbon stainless steel right cylinders, having an inner diameter of 0.805 inches. The effective density of the cesium compound is 3.27 grams per cubic centimeter. A comparison is made between a composite cesium-134, cesium-137 source and a cobalt-60 source of equal energy output. (auth)

26064 (JLI-2748-86) A FAMILY OF NEW ISOTOPIC WATER CURRENT METERS (THE DWICA'S). Final Report. (Johnston (William H.) Labs., Inc., Baltimore, Md.). Jan. 20, 1966. Contract AT(30-1)-2748. 288p. Dep. CFSTI.

Two types of deep water isotopic current analyzers (DWICA) are described. The isotopic injection time-of-drift current meters are designated DWICA I, DWICA IB, and DWICA II. DWICA I is the test model. DWICA IB is a simplified version of DWICA I and is used for relatively shallow depth operation. DWICA II is used in deep water (one mile), and includes an underwater computer system for maximum reasonable primary electronic reduction of data. The second type of instrument includes the DWICA III which is also described. DWICA III measures fluid currents by a radioisotope technique which generates long-term velocity vector averages. One printer channel records the average north-south component of current and the other channel records the average east-west component. The vectors are averaged for a specific time interval which may be varied for a few minutes to several hours. The DWICA III involves the use of a compass card, and a sealed radioactive source on the N or E point of the card and a cylindrical surrounding ionization chamber and unique graded shield. The system is either suspended from a buoy which is either buoyant or heavier than water and which is sensitive to the water currents to be measured. (F.S.)

26065 (K-1330(Add.2)) EQUILIBRIUM TIME FOR A SQUARE PLANT VARIABLE RESERVOIR INITIAL CONCENTRATIONS. Burton, D. W. (Oak Ridge Gaseous Diffusion Plant, Tenn.). Apr. 4, 1967. Contract W-7405-eng-26. 12p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

This report is an extension of the method given in UCCND Report K-1330 to allow for the effect of variations of concentration in the reservoirs at startup in the time necessary to reach equilibrium. The initial concentrations can be different in either the top or bottom sampling reservoirs, or both. The analysis is restricted to plants of small concentration, but the equilibrium time results should be applicable to all concentrations. (auth)

26066 (NP–16474) RAPPORT D'ACTIVITES, 1965. (Report of Activities, 1965). (Commissariat a l'Energie Atomique, Tunis (Tunisia)). 80p. (In French). Dep. mn.

An outline is given of the activities of the Tunisian CEA during 1965. These include reactor project, prospecting, nuclear physics, use of radioisotopes, protection against and control of radiations, and solar energy. Relations with national, international, and foreign organizations are summarized. (J.S.R.)

26067 (ORNL–4092) RADIOISOTOPE SOURCE SAFETY TESTING. Haff, K. W.; Niemeyer, R. G.; Robinson, R. A. (Oak Ridge National Lab., Tenn.). May 1967. Contract W-7405-eng-26. 157p. Dep. CFSTI.

The work of the Radioisotope Source Capsule Safety Testing Program, Oak Ridge National Laboratory (ORNL), through October 1966 is reported. Several hundred structural stress and temperature stress tests have been carried out on a wide variety of radioisotope source capsules. A method of classifying source capsules according to their containment integrity by using simple test procedures has been formulated. (auth)

26068 (SC-RR-66-2672) REENTRY THERMAL ANALYSIS OF THE SNAP-19/NIMBUS B/AGENA SYSTEM. Klett, Robert D. (Sandia Corp., Albuquerque, N. Mex.). Mar. 1967. Contract AT(29-1)-789. 134p. Dep. CFSTI.

The reentry thermal analysis used to evaluate the need for AGENA destruct and generator eject systems on the NIMBUS B/SNAP-19 mission is presented The initial configurations investigated were randomly tumbling generators, generators on the NIMBUS B, and the generators and the NIMBUS B on the AGENA, with and without the exit heat shroud. Initial conditions ranged from those associated with orbital decay to preorbital aborts caused by AGENA thrust termination. The results of this analysis indicate that nothing would be gained by using an eject system and that the need for an AGENA destruct system is marginal. (auth)

26069 (TID–23659(Vol.3)) 250-WATT RADIOISOTOPE THERMOELECTRIC GENERATOR FEASIBILITY STUDY. VOLUME III. RTG HANDLING SYSTEM ANALYSIS AND DESIGN. Final Report. (Lockheed Missiles and Space Co., Sunnyvale, Calif.). Nov. 30, 1966. Contract AT(29-2)-2049. 213p. (LMSC–2049-S001). Dep. CFSTI.

The feasibility of loading and handling the 250 W Radioisotope Thermoelectric Generator (RTG) was established from methods and concepts within existing technology. Initially a shielded system will be used to acquire operating experience for ground handling equipment and personnel and to establish confidence and acceptance for ^{90}Sr fuel RTG launch operations. Later operations can utilize an unshielded system which offers increased capability. The two systems will use the same generator storage, preparation for loading, and transportation equipment. The shielded system employs a liquid Hg biological shield mounted externally on the nose of the Nimbus spacecraft. The shield will completely surround the RTG. A system is provided for draining the Hg prior to liftoff. The outer shell of the shield serves as the nose of the shroud during ascent. The unshielded system consists of a remotely operated electromechanical work system capable of removing the RTG from a lead shielded transfer cask and installing it in the spacecraft. (F.S.)

26070 RADIOISOTOPE X-RAY FLUORESCENCE AND RADIATION SCATTER TECHNIQUES IN MINING AND METALLURGY. Berry, P. F. (Atomic Energy of Canada Ltd., Ottawa). Can. Mining Met. Bull., 60: 441-9(Apr. 1967).

Many examples of radioisotope x-ray fluorescence for analysis of metallic minerals, finished metals, and alloys and also for the continuous measurement of metallic coatings, such as Sn and Zn, on steel are described. Radiation scatter techniques are also described for certain analyses and for thickness and density measurements. (auth)

26071 FIXATION OF PHOTOELASTIC FRINGE PATTERNS BY GAMMA RAYS. Miyazono, Shohachiro (Japan Atomic Energy Research Inst., Tokyo). J. Appl. Phys., 38: 2319-23(Apr. 1967).

It is shown that photoelastic fringe patterns may be preserved at room temperature by γ-ray irradiation of loaded specimens. The samples used in this experiment were prepared from a mixture of epoxy resin and curing reagent (hardener) of the weight ratios of 100 to 12. The effect of irradiation curing was also studied as a function of the irradiation dose and the concentration of the curing reagent. It was seen that the fringe patterns are retained nearly 100% if the total dose is about 2.0×10^8 R. As an example, a bending test is shown. (auth)

26072 SPECIAL GLOVE-BOX FOR PREPARATION OF Th–B SOURCES. Bergman, C. (Uppsala Univ.). Nucl. Instrum. Methods, 52: 122-4(June 1967).

A special glove-box for preparation of Th-B sources is described. It is constructed with special consideration of protection from gaseous daughter activities of ^{228}Th. It is shown that the accelerating voltage should not be higher than 500 V and that the source geometry has an important effect on the source strength and the shape of the thorium A-line. (auth)

26073 ADVANCES WITH OPTIMIZATION OF ELECTROMAGNETIC ISOTOPE SEPARATORS. Timpl, F.; Tyrroff, H. (Institut fuer Stabile Isotope, Leipzig). Kernenergie, 10: 21-4 (Jan. 1967). (In German).

The influence of temperature of the oven and of the cathode on the performance of electromagnetic isotope separators was previously investigated. The studies undertaken for optimization of the separator operation, were extended to further parameters. The dependence of the intensity of collector current and of the resolving power on temperature of discharge chamber, on width of emission slit, on focusing voltage of extracting system, on pressure in the vessel, and on position of the collector system are explained. (auth)

26074 STUDIES ON THE COMBINATION OF A RESERVOIR AND A THERMAL DIFFUSION COLUMN. Shimizu, Masami (Showa Denko K.K., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 4: 84-97(Feb. 1967). (In French).

The heat siphon is used to enrich isotopes present in a reservoir into a thermal-diffusion column. K. Clusius and H. H. Bühler developed an alternative method, the gas oscillator, which they utilized as a gas-connecting method. Both methods were analyzed mathematically, resulting in the conclusion that the flow rate $|\sigma_R|$ (g/sec) of the heat siphon and of the gas oscillator should have a value ranging from 3 to 5H, and that the period of the gas oscillator 2T(sec) has little influence on the enrichment process, which permits a value convenient for operation to be chosen. (tr-auth)

26075 SEMI-ANALYTICAL ESTIMATION OF GAMMA-RAY INTENSITY FROM A VOLUME SOURCE. Kanemori, Yoshihiko (Mitsui Shipbuilding and Engineering Co., Ltd., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 4: 98-9(Feb. 1967).

Semi-analytical methods for estimating total γ-dose rates from a cylindrical source using a line or disk source were investigated. If a cylindrical source is divided into many line source elements and the dose rates of the γ radiation radiated from each line source are determined, the total dose rates are obtained by integrating the dose rates over the base. In disk source elements, total dose rates are obtained by integration over the height. A relatively good estimation of the γ radiation intensity from a volume source is obtained. (F.S.)

26076 STATISTICAL TIME LAGS IN GAS DISCHARGE GAPS IRRADIATED WITH A RADIOACTIVE MATERIAL. Blair, D. T. A.; Farish, O. (Univ. of Strathclyde, Glasgow). Brit. J. Appl. Phys., 18: 597-604(May 1967).

Theoretical values of mean statistical time lag were estimated for overvoltages of up to 5% for a uniform-field discharge gap of 2 cm length in nitrogen at 400 torr and 20°C, with 2 mCi of cobalt-60 located in the cathode. The results are in reasonable agreement with measured values, and indicate that in order to render the mean statistical time lag negligible in comparison with the formative time lag under these conditions it would be necessary to increase the strength of the radioactive source to about 30 mCi. When the source is located in the anode it is not possible to estimate reliable theoretical values because of the difficulty of making reasonable simplifying assumptions regarding the distribution of initial ionization close to the cathode surface; the measured values do not differ by a factor of more than two from those obtained with the source in the cathode. (auth)

26077 HEATING IN INFINITE CYLINDERS BY UNIFORM GAMMA-RAY SOURCES. Nestor, C. W. Jr.; Claiborne, H. C. (Oak Ridge National Lab., Tenn.). Nucl. Sci. Eng., 27: 472-5 (Feb. 1967).

The point kernel describing the transfer of gamma-ray energy for the case of sources distributed uniformly throughout a right circular cylinder of infinite length was integrated. Since the coefficients were available for a third-degree polynomial representation of the energy-absorption buildup factor for several materials, this representation was chosen. The reduction of the solution to a single numerical integration, the derivation of an analytical expression for the contribution from the linear term in the buildup factor expansion, and the numerical integration procedure are described. (M.H.R.)

26078 FIGURE OF COUNTING MERIT FOR COMPARING SAMPLE COUNTS. Kawin, Bergene (Veterans Administration Hospital, Washington, D. C.). Nucleonics, 25: No. 4, 69-70(Apr. 1967).

A figure of counting merit is discussed for accurate comparisons of the counting of radioisotope samples. (B.G.D.)

26079 INDUSTRIAL APPLICATIONS FOR ISOTOPIC POWER GENERATORS. Joint UKAEA-ENEA International Symposium, A.E.R.E., Harwell, September 1966. Paris, European Nuclear Energy Agency, 1967. 730p. FF 92; FS 84; DM 76,50; £ 6.14s; $22.00. (CONF-660951).

Forty-four papers on the industrial applications for isotopic power generators are presented. Individual abstracts were prepared for 42 papers. Two papers on power supply requirements were omitted. (L.C.L.)

For abstracts of individual papers see: 26020, 26055, and 26080–26119.

26080 INTRODUCTION TO ISOTOPIC GENERATORS. Dunn, P. D. (Univ. of Reading, Eng.). pp 31-9 of Industrial Applications for Isotopic Power Generators. Paris, European Nuclear Energy Agency, 1967.

The nature of direct conversion processes is outlined with special reference to isotopic heat sources and the different methods of converting heat to electricity. Possible applications for different types of isotopic generators are reviewed. (auth)

26081 PROSPECTS OF USING RADIOISOTOPES IN SPACE. Contzen, J. P. (European Space Vehicle Launcher Development Organization, Paris). pp 43-54 of Industrial Applications for Isotopic Power Generators. Paris, European Nuclear Energy Agency, 1967.

The uses of radioisotopes in space are identified. Attention is concentrated on the two major categories of application: propulsion and electric power generation. A tentative selection of the most suitable isotopes is made for both types of system, and problems which arise from their development are analyzed. Utilization prospects are projected from this analysis, particularly from a European point of view. (auth)

26082 POWER REQUIREMENTS FOR SPACE SATELLITES. Squires, D. M.; Young, R. W. (Hawker Siddeley Dynamics Ltd., London). pp 55-72 of Industrial Applications for Isotopic Power Generators. Paris, European Nuclear Energy Agency, 1967.

The European space programs, both at national and international levels, are reviewed, and the requirements for power generation for scientific, military and communication satellites in the next decade are examined. The present and future systems of power generation are discussed and the comparative performance of systems using isotopes examined in relation to the constraints of minimum weight and high reliability imposed on satellite borne equipment. A survey of the types of isotope systems presently under development or projected are discussed. The factors influencing the choice of isotope are presented in the light of the very stringent safety precautions that must be observed both before launch, as a result of failure during launch or in the event of satellite re-entry. The changes in satellite configuration resulting from use of such power systems are also examined. The future of isotopic power generation systems in relation to the European space program is discussed and the development requirements and time scales are examined. (auth)

26083 DEMANDS ON THE POWER SUPPLIES FOR LONG RANGE TELECOMMUNICATIONS. Ziegler, A. (Siemens and Halske AG, Munich). pp 85-90 of Industrial Applications for Isotopic Power Generators. Paris, European Nuclear Energy Agency, 1967.

Long-life energy sources with a minimum of maintenance are desirable for the remote radio relay stations required in long range telecommunications systems. Transistors have reduced the power supply required, and it is also desirable to reduce the size of the power supply equipment. Therefore, there is a strong interest in installing long-life and maintenance-free primary energy sources such as isotopic power generators matched to the power demands of the telecommunications systems. (L.C.L.)

26084 NOTES ON THE POSSIBILITY OF UTILIZING ISOTOPIC THERMOELECTRIC GENERATORS FOR POWERING TELECOMMUNICATIONS EQUIPMENT. Sawyer, L. R. (GEC (Telecommunications) Ltd., Coventry, Eng.). pp 91-8 of Industrial Applications for Isotopic Power Generators. Paris, European Nuclear Energy Agency, 1967.

The power requirements for microwave radio relay stations in a communications system between main centers of population with large areas of undeveloped territory intervening are outlined. An indication is given of the factors which have to be considered in assessing the merits of isotopic power generators as compared with a diesel generator power supply. (auth)

26085 ISOTOPIC THERMOELECTRIC GENERATORS FOR THE SUPPLY OF POWER TO SUBMERGED REPEATERS IN SUBMARINE TELEPHONE CABLE SYSTEMS. Foot, G. H. (Submarine Cables Ltd., Greenwich, Eng.). pp 99-114 of Industrial Applications for Isotopic Power Generators. Paris, European Nuclear Energy Agency, 1967.

A detailed study is presented of the requirements for individual power sources for submerged repeaters in submarine telephone cable systems. These requirements include unvarying power supply for a continuous period in excess of 20 years without the necessity of maintenance or access, a reliability equivalent to the failure of not more than one unit in 400 over that period, and competitively low cost. With reduced power consumption due to transistorized repeaters, it may be possible to construct isotopic generators to satisfy these requirements. The problems of designing a suitable generator and a description of a generator now under construction are given. (L.C.L.)

26086 PROSPECTS FOR THE USE OF ISOTOPIC POWER SOURCES IN CIVIL AVIATION COMMUNICATIONS AND NAVIGATION SYSTEMS. Clark, J. O. (British Overseas Airways Corp., Eng.); Whiddett, S. D.; Meadows, R. C.; Young, R. A. pp 123-45 of Industrial Applications for Isotopic Power Generators. Paris, European Nuclear Energy Agency, 1967.

The significance of the civil air transport system is outlined with particular reference to the use of advanced technology. An analysis is made of the use of power sources for civil aviation communication and navigation aids. Both airborne and ground environments are considered providing an indication of the facility operational requirements and consequent power levels. The significance of the freedom presented to communication and navigation facility siting by long-life radioisotope power generators is emphasized. Specific proposals are made for the evaluation of a navigation equipment presently available in the U.K. at both U.K. and overseas sites, allowing an analysis of operational and economic implications. (auth)

26087 NOTE ON AUTOMATIC WEATHER STATIONS. pp 153-5 of Industrial Applications for Isotopic Power Generators. Paris, European Nuclear Energy Agency, 1967.

The operational requirements for automatic weather stations are outlined and the range of power source output required is indicated. (auth)

26088 USE OF RADIOISOTOPIC THERMOELECTRIC GENERATORS IN AIDS TO NAVIGATION IN SWEDEN. Hallengren, L.; Hjertberg, C. G.; Ulvoenaes, S. (Swedish National Board of Shipping and Navigation, Stockholm). pp 165-9 of Industrial Applications for Isotopic Power Generators. Paris, European Nuclear Energy Agency, 1967.

In order to investigate the possibilities of cutting down the operation costs of small lighthouses in the Swedish archipelago with difficult access, the National Board of Shipping and Navigation decided to install and operate a radioisotopic thermoelectric generator in a lighthouse in the Stockholm area. The investigation is expected to clarify the problems which may arise as a result of the use of isotopic power sources. (auth)

26089 SMALL POWER SOURCES FOR INSTRUMENTATION AND AUTOMATED EQUIPMENT IN DEEP OCEAN ENGINEERING. Jones, R. E. (Naval Civil Engineering Lab., Port Hueneme, Calif.). pp 171-81 of Industrial Applications for Isotopic Power Generators. Paris, European Nuclear Energy Agency, 1967.

The work of the U. S. Naval Civil Engineering Laboratory with small power sources for oceanographic instrumentation and automated equipment is outlined. Because the limitations imposed by chemical battery power on long-term data collection have been found to be significant, an alternative power source is needed. The possibility of using nuclear energy to generate power at the very low levels required may offer an economical solution to the problem. The Naval Civil Engineering Laboratory will devise and conduct a test and evaluation program for radioisotope power sources. It is anticipated that work will commence when the first devices are received, probably by November 1966. (auth)

26090 ENERGY REQUIREMENTS IN THE STUDY AND EXPLORATION OF OCEANS. Dumas, J. C. (Musee Oceanographique, Monaco, France). pp 183-90 of Industrial Applications for Isotopic Power Generators. Paris, European Nuclear Energy Agency, 1967. (In French).

One of the greatest difficulties in oceanographic studies is the necessity of energy transport between the surface and the various exploration machines. Different energy needs are present according to whether the machine is inhabited or not. The energy needs for inhabited machines (bathyspheres, Argyronete, and underwater dwellings) are high and are tabulated. The energy requirements for automatic data-gathering instruments are much lower. These are also indicated. (J.S.R.)

26091 CATHODIC PROTECTION AGAINST CORROSION AND THE APPLICATION OF ISOTOPE BATTERIES. Kammpermann, H. (Wilhelm Quante AG, Ger.). pp 191-3 of Industrial Applications for Isotopic Power Generators. Paris, European Nuclear Energy Agency, 1967.

Corrosion is considered as an electrochemical process and the basic characteristics of cathodic protection are outlined. The range of possible applications of this technique is mentioned. Electric power supply requirements are assessed, with particular reference to cost of supply, and power supply problems in remote areas considered. Examples of apparatus and protection systems are given. (auth)

26092 REQUIREMENTS AND APPLICATIONS OF LOW POWER ENERGY FOR MEDICAL USE. Elmqvist, R. (AB Elema-Schoenander, Fack Solna, Sweden). pp 197-202 of Industrial Applications for Isotopic Power Generators. Paris, European Nuclear Energy Agency, 1967.

Possible applications of miniature power sources in the medical field are surveyed. The different types of pacemakers from the aspect of construction, applications, and energy requirements are discussed. Other possible applications, such as deaf aids are briefly reviewed. (auth)

26093 POWER SOURCE REQUIREMENTS IN MINIATURIZED ELECTRONIC AND MECHANICAL EQUIPMENT. Vittoz, B. (Univ., Lausanne, Switzerland); Zangger, C. pp 209-14 of Industrial Applications for Isotopic Power Generators. Paris, European Nuclear Energy Agency, 1967.

Some general considerations of the historical motivation for the development of miniaturised batteries and of the actual state of the classical and nuclear techniques in this field are reviewed. The respective characteristics of chemical and nuclear batteries and the advantages which a development of nuclear batteries in the power range of 1 μW(e) to 1 MW(e) might confer in the field of electronic and mechanical microtechniques are presented. An examination of the power units required by mechanical microinstruments, which have been well established for some time and by electronic micro-circuits, which are now beginning to appear on the market and whose development is still going on, leads to the conclusion that the market for miniaturized batteries will be substantially enlarged in the future in the power range from 1 μW(e) to 1 MW(e). In this power range the cost of the radioactive source for the nuclear batteries appears to be acceptable from the economic point of view. Some fields of application and typical utilizations which could benefit from the increased reliability which instruments based on the combination of nuclear micro-batteries and electronic micro-techniques are likely to possess are discussed. Some factors limiting these applications such as the requirements of economic industrial production and of safety are mentioned. (auth)

26094 USE OF RADIONUCLIDE BATTERIES TO POWER ELECTRIC AND ELECTRONIC CLOCKS. Kuner, S. (Kieninger und Obergfell, St. Georgen/Schwarzwald, Ger.). pp 215-34 of Industrial Applications for Isotopic Power Generators. Paris, European Nuclear Energy Agency, 1967.

During the past ten years the electric battery clock has been widely used as a so-called domestic clock and has thus largely supplanted the classical clock with mechanical winding. In addition the electronic clock characterized by its reliability and high accuracy has met with a ready market. In this connection the need for a long-lived, safely operating power source to drive electric and electronic clocks was discussed and it was natural that interest preferably turned towards atomic energy. Therefore, the problems and technical requirements of using nuclear batteries to power electric and electronic clocks are reviewed, and potential solutions to these problems given. (auth)

26095 SUPPLY OF RADIOISOTOPES FOR POWER. Dominguez, G. (Junta de Energia Nuclear, Madrid). pp 241-58 of Industrial Applications for Isotopic Power Generators. Paris, European Nuclear Energy Agency, 1967.

In spite of the very large number of different nuclides that occur in the nature or that may be made by the man, the number of them actually useful as practical heat sources is very limited. The decision upon the possibility of using a certain nuclide as a heat source must be taken by applying certain criteria such as: half-life, power density, energy reserve, health hazards, availability, chemical and physical form, and finally, cost and application field. The list of presently useful nuclides is thus reduced to about a dozen (cobalt-60, strontium-90, cesium-137, cerium-144, promethium-147, polonium-210, actinium-227, thorium-228, uranium-232, plutonium-238, curium-242 and curium-244). A survey is made of their preparation methods, properties, and application fields, as well as of their actual or potential availability in Europe. (auth)

26096 PROSPECTS FOR PRODUCTION OF ^{90}Sr AND ^{137}Cs SOURCES IN FRANCE. Courouble, J. M.; Fradin, J. (CEN, Saclay, France). pp 259-64 of Industrial Applications for Isotopic Power Generators. Paris, European Nuclear Energy Agency, 1967. (In French).

The increasing interest in the utilization of isotopic generators has led the CEA to attempt to satisfy the source needs during the next few years. The chemical procedure for the extraction of ^{137}Cs and ^{90}Sr is at the point of the construction of a pilot installation for industrial production. Its annual capacity would be a million curies (ELAN project) and the means employed are economical. Since 1961 it has been possible to obtain high activity sources of ^{137}Cs and soon after of ^{90}Sr. These sources are fabricated from fission wastes from French reactors. It will be possible to develop sources from Cs and Sr compounds bought from the United States. (J.S.R.)

26097 APPLICATIONS OF FISSION PRODUCTS FOR LARGE HEAT SOURCES. Cochran, J. S. (Isochem Inc., Richland, Wash.). pp 265-76 of Industrial Applications for Isotopic Power Generators. Paris, European Nuclear Energy Agency, 1967.

Fission product heat sources of complete dependability, long life and reasonable cost are now a reality. Sources have been fabricated with heat outputs from a few tenths of a watt to well over a thermal kilowatt, and both the source material and fabrication techniques are available to extend the sizes by more than an order of magnitude. The isotopes of prime interest for heat sources are discussed in detail. Commercial availability and fuel forms are reviewed, both for the present time and upon completion of the Fission Products Conversion and Encapsulation Facility in 1968. (auth)

26098 EXPERIENCE WITH OPERATING RADIOISOTOPE-FUELED THERMOELECTRIC GENERATORS. Morse, J. G. (Hispano-Martin, Bois-Colombes, France). pp 285-99 of Industrial Applications for Isotopic Power Generators. Paris, European Nuclear Energy Agency, 1967.

Continuing and increasing needs for small reliable sources of electrical power led the U.S.A.E.C. in 1956 to contract with Martin Company, to explore the feasibility of producing electrical energy from the decay heat of radioisotopes. The resulting program, called SNAP (Systems for Nuclear Auxiliary Power), has engendered a new technology encompassing the use of radio-nuclides coupled with static thermoelectric converters as unique sources of compact, long-lived power. In addition, all hardware produced and under development reflects detailed and thorough analyses and tests of nuclear safety characteristics peculiar to the operational use of the device. SNAP developments in terms of their end use, and the evolution of design towards modularization of thermoelectric converters are discussed. The reliability and performance of the system and future engineering needs for continued growth of this technology are described. (auth)

26099 UKAEA RIPPLE PROGRAM. Yeats, F. W. (Atomic Energy Research Establishment, Harwell, Eng.). pp 309-29 of Industrial Applications for Isotopic Power Generators. Paris, European Nuclear Energy Agency, 1967.

An investigation was made of various methods of directly converting heat to electricity which could be used in conjunction with nuclear power. Thermoelectric conversion with radioisotopes as the source of primary heat energy was considered. The work resulted in the conception of the RIPPLE type of isotopes-powered thermoelectric generator in which ^{90}Sr is the heat source. Possible applications of isotopic generators are reviewed, and it was concluded that the main terrestrial market would be for marine navigation lights. Two demonstration generators for this purpose were developed and exhibited, and a third prototype device is being laboratory tested. (L.C.L.)

26100 THERMOELECTRIC MATERIALS DEVELOPMENT FOR THE RIPPLE PROGRAM. Hare, G. E. (Atomic Energy Research Establishment, Harwell, Eng.). pp 331-8 of Industrial Applications for Isotopic Power Generators. Paris, European Nuclear Energy Agency, 1967.

A great deal of work has been done in the last decade, particularly in the U.S.A., to develop thermoelectric materials for power generation. A wide range of materials has been investigated and reported, and some have found application in actual generators. Development of thermoelectric materials is still proceeding and although high conversion efficiencies are unlikely to be attained there is the prospect of an improvement on currently available materials which should make the isotope powered thermoelectric generator economically more attractive. The design principles on which the U. K. Atomic Energy Authority's work has been based and the progress towards achieving satisfactory units are described. (auth)

26101 DEVELOPMENT OF NUCLEAR CONVERSION THERMOELECTRIC POWER GENERATORS. Phillips, L. S.; Christie, I. R. A.; Planer, G. V. (G. V. Planer Ltd., Sunbury-on-Thames, Eng.). pp 339-47 of Industrial Applications for

Isotopic Power Generators. Paris, European Nuclear Energy Agency, 1967.

The physical properties of thermoelectric materials for isotopic power generators were investigated and evaluated as a part of the RIPPLE program in order to increase both the efficiency and operating temperature limits of these generators. Generator modules were fabricated from the most promising materials. These devices have performed satisfactorily in the 450° to 550°C range on six months' load tests with no significant variation in output. (L.C.L.)

26102 GERMANIUM–SILICON THERMOELECTRIC MATERIAL DEVELOPMENT. Piper, M. J. (Plessey Co. Ltd., Towcester, Eng.). pp 349-61 of Industrial Applications for Isotopic Power Generators. Paris, European Nuclear Energy Agency, 1967.

The powder metallurgical technique used to make heavily doped n- and p-type Ge–Si alloys is described. Measurements of α and ρ of these hot-pressed alloys are reported. A comparison is made between the hot-pressed Ge–Si alloys and similar alloys made using a zone-levelling technique. The above metallurgical technique has been extended to fabricate, in one operation, complete multicouple generator blocks. A description of the multicouple blocks is given and a theoretical assessment of their performance made. (auth)

26103 THERMIONIC ISOTOPIC GENERATOR WITH ^{238}Pu. Clemot, M.; Devin, B.; Durand, J. P.; Semeria, J. (CEN, Saclay, France). pp 383-97 of Industrial Applications for Isotopic Power Generators. Paris, European Nuclear Energy Agency, 1967. (In French).

The general arrangement of a thermoionic converter suitable as an auxiliary power source is described. The description includes the caloduct system for the emitter and for the collector. The energy source is ^{238}Pu and the generator is designed to furnish 50 W. (tr-auth)

26104 HEAT PIPES FOR THERMIONIC CONVERTER WITH ISOTOPIC FUEL. Semeria, R.; Schmidt, E. (CEN, Grenoble, France). pp 399-409 of Industrial Applications for Isotopic Power Generators. Paris, European Nuclear Energy Agency, 1967. (In French).

Some results of the calculation of the design of a heat pipe for the emitter of the thermionic converter with 500 W(t) isotopic source were given. A sodium prototype was constructed and tested from 600 to 900°C in order to verify the satisfactory operation of the heat pipe in weightless regime. In the case of lead or silver heat pipes (1500°C) the importance of acceleration forces, which can affect the operation of the heat pipes at the time of launching, was emphasized. (tr-auth)

26105 PROBLEMS POSED BY THE STUDY OF A RADIOISOTOPIC GENERATOR OF ELECTRICITY FOR SPACE. Eidelmann, D. (SNECMA, Suresnes, France); Guennoc, H. pp 415-24 of Industrial Applications for Isotopic Power Generators. Paris, European Nuclear Energy Agency, 1967. (In French).

A study was undertaken to develop a 10 W(e) space generator prototype using a heat source of ^{90}Sr titanate. The conversion of heat into electricity would be made by means of doped Ge–Si thermocouples. In this study various points of view were examined: (1) minimum mass for fixed operational conditions; (2) flexibility of operation higher than a minimum fixed value for the duration considered; (3) structure compatible with admissible norms for various possible accidents; and (4) integration of the generator to the rocket or satellite. The study made considered only the first point of minimum mass for 5-years' operation at 10 W(e). The number of thermo-elements used, the cold temperature of the thermo-element, hot temperature of the thermo-element, materials chosen and arrangement adopted, and geometric form of the radioactive source were the parameters selected in the study. The work program and the first physical measurements in the study are reported. (tr-auth)

26106 DEVELOPMENT OF A RADIOISOTOPE THERMOELECTRIC POWER GENERATOR. Zahn, P. (Boelkow GmbH, Ottobrunn, Ger.). pp 435-50 of Industrial Applications for Isotopic Power Generators. Paris, European Nuclear Energy Agency, 1967.

The status of the development work of a thermoelectric conversion system is outlined and a special compact GeSi-converter element is presented. With these elements an actual model of a space power generator with an electrical output of 125 W was constructed. The model was subjected to vacuum tests with an electrical simulated heat source. In addition, an outlook is given on the future performance characteristics of radioisotope thermoelectric power generators. (auth)

26107 ISOTOPE BATTERY WITH THERMOELECTRIC GENERATOR. Menke, H. H.; Schmidt, E. F. (Allgemeine Elektrizitaetsgesellschaft, Hamburg). pp 451-9 of Industrial Applications for Isotopic Power Generators. Paris, European Nuclear Energy Agency, 1967.

The requirements of an isotopic battery are low weight, high reliability, and high efficiency. Low weight can be obtained by the use of aluminum, magnesium, and alloys of these elements for the manufacture of construction parts, and the selection of an isotope fuel such that the weight of the radiation shielding is as low as possible. Reliability and high efficiency are a function of the operational temperature. A high temperature differential of the thermocouples is essential to high efficiency of the thermoelectric converters, and, therefore, results in the most economical use of the isotopic heat source energy. However, a high operating temperature decreases the reliability of isotopic batteries due to decreased material strength to resist shock and vibration damage. An optimum operating temperature condition considering both reliability and efficiency must be obtained. Since the construction of an isotopic battery is already technically solved, the application of such systems is but a question of how the costs of the isotopes can be reduced. (L.C.L.)

26108 EURATOM'S ACTIVITY ON RADIOISOTOPE POWERED THERMOELECTRIC AND THERMIONIC GENERATORS. Gillot, R. H.; Neu, H.; van Andel, E. (EURATOM, Ispra, Italy). pp 461-82 of Industrial Applications for Isotopic Power Generators. Paris, European Nuclear Energy Agency, 1967.

Design studies of generators using a thermoelectric conversion system were carried out for a 5 W(e) generator based on Pb Te thermoelectric couples, powered with a thulium-170 source. A demonstration device of a "sandwich" type (two modules of couples in series on both sides of the flat isotopic source) has been constructed and tested by electrical heating. Some studies have been made on electrode-element bonding. The heat source (in preparation) will be made of 15 small tubes filled with Tm_2O_3 pellets and pressed between metal plates. A parameter study for a 50 W(e) generator with Ge Si elements and an actinium-227 source shows that units with reduced size and weight should be producible for space application. Replacing the thermoelectric system by a thermionic converter has the advantage of a higher thermal efficiency. Parameter and design studies on radioisotope powered thermionic generators show however a rather strong decrease in the efficiency with decreased power output below 50 W(e). The importance of using a new heat transfer system, called heat pipes, for heat removal and heat flux concentration is discussed. (auth)

26109 THERMOELECTRIC GENERATOR OF VERY LOW POWER WITH RADIOISOTOPES STUDIED UNDER EURATOM CONTRACT. Brouee, R. (Hispano-Suiza, Boise-Colombes, France). pp 489-92 of Industrial Applications for Isotopic Power Generators. Paris, European Nuclear Energy Agency, 1967. (In French).

A very small radioisotopic thermoelectric generator (several tenths of a watt) is being developed. The advantages of such a generator are discussed. It should be possible to construct the generator since the techniques were already developed. The applications of a very low power generator are discussed. (J.S.R.)

26110 SURVEY OF POTENTIAL DYNAMIC CONVERSION SYSTEMS OF ISOTOPIC POWER. Dunn, P. D.; Hammerton, J. C. (Univ. of Reading, Eng.). pp 497-516 of Industrial Applications for Isotopic Power Generators. Paris, European Nuclear Energy Agency, 1967.

A survey has been made of potential dynamic conversion systems which meet the need for small (below 10 kW), long life reliable power sources utilizing radioisotopes in order to determine the nature of further development required to promote its commercial exploitation. The survey covers availability and costs of radioisotope heat sources based on current and estimated future production costs. It reviews thermodynamic cycles and heat engines indicating the limitations and problem areas. (auth)

26111 NUCLEAR STIRLING ENGINE. van Nederveen, H. B. (Reactor Centrum Nederland, Petten, Netherlands). pp 517-24 of Industrial Applications for Isotopic Power Generators. Paris, European Nuclear Energy Agency, 1967.

Some general possible design concepts are given for a nuclear heated Stirling engine. Interesting nonconventional application areas are pointed out in a brief review. One special application area for a first prototype is named and some desired specifications are formulated. (auth)

26112 STIRLING ENGINE, PRESENT AND FUTURE. van Witteveen, R. A. J. O. (Philips Gloeilampenfabrieken Research Labs., Eindhoven, Netherlands). pp 525-56 of Industrial Applications for Isotopic Power Generators. Paris, European Nuclear Energy Agency, 1967.

A short historical and technical survey of the Stirling engine developments is given. Up to now a number of prototypes have been made ranging up to 100 bhp per cylinder. Test results are reported. They indicate that efficiencies are in the range of well-designed diesel engines (close to 40%). It is shown that improved results (up to 45 or 50%) may soon be expected. Difficulties inherent in the Stirling engine, e.g., the dynamic sealing of hydrogen or helium at 100 atmospheres or more are described. The basic principles of the Stirling cycle and their application in a modern engine are given. The prospects of the Stirling engine in the near future and its special advantages which may even open up new fields of application are discussed. The possibilities for use in the field of nuclear energy, which seem very attractive, are treated at greater length. (auth)

26113 SURVEY OF THE ISOTOPE FUELED SMALL RANKINE CYCLE POWER UNIT. Ottesen, R. (Junkers Flugzeug- und Motorenwerke AG, Ger.). pp 557-79 of Industrial Applications for Isotopic Power Generators. Paris, European Nuclear Energy Agency, 1967.

Isotope fueled Rankine cycle power conversion plants are discussed. Space achievements and efforts towards a small power unit under development are described. The importance of suitable working fluids, particularly for terrestrial applications, stands in the foreground for cycle considerations, and especially organic fluids are found to give great promise for the special requirements of cycle components. The reliability of these fluids as to thermal stability and irradiation resistance has yet to be verified experimentally. Likewise reliable enthalpy diagrams should be elaborated. The results of a terrestrial system layout showing the overall performance versus plant size are indicated, and suggestions are made how to cope with miniaturized primemovers yet maintaining tolerable system efficiency. If required, outputs as low as 200 watts are within actual reach. Estimating pros and cons of hot and organic cycles seems to favor the organic one. The most important item is the relatively moderate cost of development. A two year research period should be sufficient to establish a fully tested closed-loop pilot plant. (auth)

26114 RANKINE CYCLE POWER UNIT OPERATING WITH ISOTOPIC HEAT SOURCES. Bronicki, L. (Ormat Turbines Ltd., Yavne, Israel). pp 589-613 of Industrial Applications for Isotopic Power Generators. Paris, European Nuclear Energy Agency, 1967.

A dynamic power conversion module adaptable to isotopic heat sources is described. The concept of a hermetically sealed, Rankine cycle turbogenerator using organic motive fluids both for power and lubrication is presented. A modified Rankine cycle and the selection of a working fluid having high molecular weight plus other characteristics which are the key to good efficiency in small turbines are discussed. Many thousands of hours of continuous high speed operation accumulated during the last three years prove this type of power unit suitable for isotopic power both from reliability and power level aspect. Originally developed for terrestrial conversion of solar heat the units are now manufactured for either solar or conventional heat sources, in the power range of 200 W(e) to 1000 W(e). Units in the power range down to 50 W(e) and up to 10 kW(e) are being developed. The dynamic power conversion modules appear to be particularly suited for coupling with isotopic heat sources. (auth)

26115 LOW POWER ENERGY CONVERSION BY CHARGED PARTICLE COLLECTION. Andersson, I. O.; Svansson, I. (Aktiebolaget Atomenergi, Nykoeping, Sweden). pp 619-31 of Industrial Applications for Isotopic Power Generators. Paris, European Nuclear Energy Agency, 1967.

The possibilities of using direct particle collection for application as a low power isotope battery are discussed. In spite of the low power available —in the range of some μW—such batteries are of interest specially when a long battery life, small size and a reliable system are required. The principles for the two methods: direct collection of the primary charges and absorption in a semiconductor p-n junction are described including the criteria for the selection of the isotopes which are of main interest. For two of these isotopes, ^{238}Pu and ^{147}Pm, which are respectively pure alpha and beta emitters, calculations are given for the expected output power for some source strengths. The shielding required to reduce the dose rate to acceptable levels is discussed and an estimate of size and reliability is made. The result of experiments with direct collection of beta particles from a ^{90}Sr source is presented and examples are given where this type of low power sources already has found an application. (auth)

26116 PHOTOELECTRIC RADIONUCLIDE BATTERY AND ITS LIMITS. Scharman, A. (Univ., Giessen, Ger.). pp 645-53 of Industrial Applications for Isotopic Power Generators. Paris, European Nuclear Energy Agency, 1967.

The production of electricity using the combination radionuclide-luminophor-photoelement is reported. Based on the results of experiments, the principal limits of such a device are discussed. Batteries of this type can be used, preferably in the microwatt range. (auth)

26117 SAFETY ASPECTS OF RADIOISOTOPIC GENERATORS IN SPACE. Bryant, Pamela M. (Atomic Energy Research Establishment, Harwell, Eng.). pp 663-8 of Industrial Applications for Isotopic Power Generators. Paris, European Nuclear Energy Agency, 1967.

The potential applications of isotopic generators as sources of auxiliary power in space involve quantities of radionuclides sufficient to produce up to a few kilowatts of electrical power. In abnormal circumstances, expected to arise infrequently, most or all of the activity in the generator could be burned up on re-entry to the upper atmosphere. Prediction of the activity in surface air and in milk which would arise if a single 1 kilowatt generator with any of nine nuclides studied were burned up is based on data from weapons tests. The predicted activities are compared with reference levels derived for the purpose. In the event of burn-up of an isotopic generator in the upper atmosphere, the use of certain nuclides such as plutonium-238 or strontium-90 would present more potential problems than use of the others studied. It appears that only if the rate of failure involving premature or unplanned burn-up were to be much greater than the low rate anticipated would some restriction on their use in space be necessary. (auth)

26118 SAFETY CONSIDERATIONS IN THE TERRESTRIAL APPLICATIONS FOR ISOTOPE POWERED GENERATORS. Morley, F. (Atomic Energy Research Establishment, Harwell, Eng.). pp 669-72 of Industrial Applications for Isotopic Power Generators. Paris, European Nuclear Energy Agency, 1967.

The potential radiation hazards associated with terrestrial applications of isotope powered generators are summarized and emphasis placed on the need for high standards of containment for generator fuel. It is suggested that safety standards commanding a wide degree of international acceptance are desirable. To a large extent, however, it should be possible to borrow from codes and regulations which have already been developed for general application in the field of radiation safety. Existing regulations governing the safe transport of radioactive materials may be particularly valuable as a basis for the formulation of standards for containment integrity and tests to demonstrate compliance with these standards. (auth)

26119 ECONOMIC ASPECTS OF ISOTOPIC GENERATORS. Pollock, J. F. (Atomic Energy Research Establishment, Harwell, Eng.). pp 679-88 of Industrial Applications for Isotopic Power Generators. Paris, European Nuclear Energy Agency, 1967.

Indications are given of the probable cost of isotopic power generators and an attempt made to define the economic power range. A comparison with alternative power sources is made. Outline proposals are made for revenue as against capital expenditure to avoid the heavy initial outlay. An indication is given of developments which could reduce the present cost of isotopic power. (auth)

26120 GAS-LIQUID CONTACT COLUMNS AND TRAYS THEREFORE. (to Houilleres du Bassin du Nord et du Pas-de-Calais). British Patent 1,063,443. Mar. 30, 1967. Priority date June 10, 1963, France.

A design for a gas-liquid contact column includes a solid plate to which the liquid phase is fed. The plate has one or more vertical risers each having a height of at least 7 cm. Each riser is connected at its top to a gas-phase distribution system made up of a nest of tubes connected for gas flow to the top of the riser. The tubes are disposed around the riser and terminate close to the solid plate. (B.L.M.)

26121 IMPROVEMENTS RELATING TO BEAM DEFINING STRUCTURES. Bayes, Roger (to Associated Electrical Industries Ltd.). British Patent 1,067,753. May 3, 1967. Filed May 19, 1963.

A beam defining structure for radiation includes a frame, a number of shutters each of which has a beam defining surface, and a number of mechanisms for moving the shutters. Each mechanism includes two link members, one end of each of which is pivotally attached to the associated shutter and the other end of which is pivotally attached to the frame. The relative lengths of the link members and the relative positions of the points of attachment are such that for small movements of the shutter the beam defining surface extends substantially radially with respect to a selected point. The shutters may be connected in pairs so that they move simultaneously to define opposite sides of the beam. (B.L.M.)

Materials Testing

Refer also to abstract 26062.

26122 (CEA-R-3184) ETUDE EXPERIMENTALE DE PLAQUES MINCES CARREES ET ENCASTREES SUR LEURS QUATRE RIVES (PLAFONDS DE CAISSONS ETANCHES). (Experimental Study of Thin Square Slabs, Embedded on All Four Sides (Pressure Vessel Floors)). Valentin, Andre (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Mar. 1967. 61p. (In French). Dep.

This work was designed to test experimentally the mechanical strength of large thin plates made of non magnetic stainless steel and subjected to transverse forces; these plates are intended to be used as the flooring of pressure vessels. The plates were mounted on frames, each pillar of which had been previously prestressed at its center point, with a force of 300 kg, 600 kg, and 800 kg. The experiments showed that the amounts of flexion at the center w were related to the loads q by equations of the type: $(qa^4/Dh) = (w/h)\,[A + B(w/h)^2]$ where 2a, h and D represent respectively the length of a side, the thickness and the rigidity under flexion of the plates held on the four sides. The coefficients A and B have been determined for different cases; the equations obtained are discussed. It is shown in particular that prestressing of the pillars is beneficial but that the movement of the plates at their edges cannot be considered to be nonexistent with the setups used. (tr-auth)

26123 (GA-7810) PRESSURE VESSEL ANALYSIS BY FINITE ELEMENT TECHNIQUES. Rashid, Y.; Rockenhauser, W. (General Dynamics Corp., San Diego, Calif. General Atomic Div.). Feb. 27, 1967. Contract AT(04-3)-167. 32p. (CONF-670318-1). Dep. CFSTI.

From Institution of Civil Engineers Conference, London, England.

A brief outline of the finite element procedure for the analysis of time-dependent quasi-static structures is presented. Restricting attention to prestressed concrete pressure vessels, two types of analyses are given: (a) axisymmetric analysis in which steel reinforcement, prestressing cables and liner remain elastic but concrete is assumed to be a linear viscoelastic material obeying the superposition hypothesis; and (b) three-dimensional elastic analysis. Viscoelastic properties of concrete are represented by an experimentally determined creep function which is temperature and age dependent. Results are presented for the axisymmetric creep analysis in the form of time-histories of stresses and deformations at specified critical locations in the structure, and as stress contour plots for the three-dimensional analysis. Comparisons of experiment with axisymmetric elastic analysis of a prestressed concrete pressure vessel model are also given. (auth)

26124 (LA-3658) SHEAR STRENGTH OF SOFT-SOLDERED BRASS JOINTS AS A FUNCTION OF AGE AND TEMPERATURE HISTORY. Liebenberg, D. H. (Los Alamos Scientific Lab., N. Mex.). Jan. 11, 1967. Contract W-7405-eng-36. 7p. Dep. CFSTI.

The ultimate shear strength of overlapped joints of 60 tin-40 lead solder on brass was measured under various conditions. The effect of age up to 330 days after soldering is reported. The effect on ultimate shear strength at room temperature of from 1 to 10 cycles to 77 and 20.5°K is measured for some samples, and some evidence is found for low temperature discontinuous yielding. (auth)

26125 (SC-TM-67-121) STUDY OF SILICON OXIDE-NICKEL FILM FOR USE AS RESISTIVE ELEMENTS. Shafer, B. D. (Sandia Corp., Albuquerque, N. Mex.). Mar. 1967. Contract AT-(29-1)-789. 30p. Dep. CFSTI.

Fabrication procedures for SiO_x-Ni cermet resistors for application in high-ohm-per-square uses are described. These resistors cover the sheet resistivity range from 20 to 100,000 ohms per square ($\Omega/\square$). Temperature coefficient of resistance (TCR) range from 300 to 1500 parts per million/degree centigrade. Some films with sheet resistivities of 3,000 ohms per square have been made with TCR's of 300 to 500 ppm/°C. Long time temperature stability tests show the resistors change 5 percent or less after 500 hours at 125°C. Problems encountered are mainly in the reproducibility of films in desired ranges. In the 10,000 ohms per square region film resistivities may vary as much as 50 percent across a substrate, indicating the extreme sensitivity of resistivity in this region to process variables. In the higher and lower ranges, repeatability is much better but TCR's are higher. (auth)

26126 (SC-TM-67-307) UNSYMMETRICAL BENDING OF A PRESTRESSED ANNULAR PLATE. Alzheimer, William E. (Sandia Corp., Albuquerque, N. Mex.). May 1967. Contract AT-(29-1)-789. 24p. Dep. CFSTI.

The boundary layer technique of matched asymptotic expansions is used to obtain a solution for the deflection of a highly prestressed thin annular plate. The plate is fixed at the outer boundary and has a central rigid inclusion that is rotated out of the plane of the plate. The exact solution is also derived and it is shown that the boundary layer solution compares favorably with the exact solution. (auth)

26127 (UCRL-70174) GRAPHITE HIGH-TEMPERATURE BEARINGS. Hanner, D. W. (California Univ., Livermore. Lawrence Radiation Lab.). Jan. 30, 1967. Contract W-7405-eng-48. 40p. (CONF-670601-1). Dep. CFSTI.

For Presentation at Symposium on Lubrication in Nuclear Applications, Miami Beach, Fla.

All-graphite bearings were investigated for a high-temperature graphite helical-screw expansion engine demonstration, but appear to be applicable to a wide range of temperatures, loads, and speeds. Both sleeve and rolling-element bearings were tested. The sleeve bearings were tested to a temperature of 2850°F, 6000 rpm, and specific loads of 50 psi. Results gave a coefficient of friction of approximately 0.1 and wear of approximately 0.001 in. on both sleeve and shaft after 30 hours. The bearings were tested in argon at 1 atmosphere. Rolling-element bearings were tested at room temperature in air. Literature indicates that at temperatures above 1200°F in inert atmospheres or vacuum, results should show friction and wear characteristics similar to those obtained at ambient temperature in air. This, coupled with the fact that graphite has an increase in strength with temperature, should make room-temperature testing meaningful. Of the bearings tested, best results were obtained from the caged roller bearing. Coefficient of friction for these bearings ran from 0.0045 to 0.0085 for loads up to 1000 pounds and speeds up to 10,000 rpm. These bearings had a bore of 1.75 in., and rollers were 1 in. long with a $\frac{1}{4}$-in. diameter. One such bearing ran for over 100 hours at a load of 482 pounds. Needle bearings (full complement) were also tested, but skewing became a problem at high speeds. (auth)

26128 (ORNL-tr-1369) THE RESULTS OF ULTRASONIC TESTING IN THE PRACTICE OF MACHINE AND BOILER CONSTRUCTION CONCERNING THE MATERIAL AND STRENGTH PROPERTIES OF COMPONENTS. Meyer, Hans Juergen (Maschinenfabrik Augsburg-Nuernberg A. G., Nuremberg (West Germany)). Translated by Hans Krautwedel, Sigfred Peterson, and R. W. McClung (Oak Ridge National Lab., Tenn.), from a Thesis submitted to Technische Hochschule, Darmstadt. 222p. Dep. CFSTI. JCL $15.00 fs, $6.86 mf.

Information from nondestructive ultrasonic testing is related to the material properties and to the mechanical properties of components. New methods of using ultrasonic tests are explained, which not only find defects in the usual sense but also obtain information about material properties that otherwise could only be obtained by destructive testing. In testing turbine rotor forgings, inclusions of certain sizes and shapes are not important in operation or for safety, but in turbine blades, hidden cracks can influence stress and operational behavior. Defects found in boiler tubes were investigated as to strength behavior. A "defect area value" has been introduced which relates ultrasonic screen indications, damage to tubes, and reduced ductility. The ratio of bond echo and back surface echo is a useful measure of bond strength. This ratio provides a criterion for the practical ultrasonic inspection of bearings. The different behavior of sound waves during diffusion into material is used to determine material strength on which material behavior depends. Reasons for damage can be explained and ideas for new designs to minimize damage can be obtained through ultrasonic testing. (F.S.)

26129 CALCULATION OF THE THERMAL STRESSES IN AN AXISYMMETRIC SHELL. Curioni, Sergio. Riv. Ing. Nucl., 4: 1075-85(May-June 1966). (In Italian).

The stress state existing in an axisymmetric shell of small thickness exposed to internal pressures and to thermal loads varying with time was investigated. A numerical solution of the system of differential equations was obtained by means of the Runge-Kutta method of the fourth order modified by Gill. The program, written in Fortran 2, can be used on an IBM-7094 computer. (tr-auth)

26130 PLANE STRAIN CREEP AND PLASTIC DEFORMATION ANALYSIS OF A COMPOSITE TUBE. Yalch, J. P.; McConnelee, J. E. (General Electric Co., Cincinnati). Contract AT(40-1)-2847. Nucl. Eng. Design, 5: 52-62(Jan.-Feb. 1967).

A method of analysis and associated computer program is described for the generalized plane strain analysis of transient creep and plastic deformations of composite cylinders. The material properties are permitted to vary with temperature and the axisymmetric loading conditions may vary with time. The loading may include any combination of internal pressure, external pressure, axial load and radial variation of thermal strains. Several forms of creep law are permitted including an iso-curve plastic strain law for use in obtaining certain plasticity solutions from the creep solutions. (auth)

26131 DETERMINATION OF TEXTURE ON NUCLEAR MATERIALS BY MEANS OF X-RAY AND NEUTRON DIFFRACTION. Baffigo, V.; Domenici, M. (Societa Ricerche Impianti Nucleari, Saluggia, Italy). Atompraxis, 13: 121-5(Mar. 1967).

In view of the important role played by the structural anisotropy of materials for nuclear reactors, some methods for texture examination and quantitative determination are reviewed. Experimental investigation of uranium by various working techniques is shown as an example for the application of such methods. Work performed at the Sorin Center on texture determination, both in uranium and graphite, and also for structural characterization and for radiation damage inspection, is likewise described. (auth)

Protective Structures

26132 (ORNL-tr-1646) INVESTIGATIONS ON THE PROBLEM OF THE INTERRELATIONSHIP OF PRESSURE STRENGTH, SIZE, AND COST OF MULTIPURPOSE BUILDINGS FOR A FEDERAL TRANSPORTATION ADMINISTRATION. Girnau, Guenther. Translated for Oak Ridge National Lab., Tenn., from a German Report. 63p. Dep. CFSTI. JCL $6.60 fs, $2.09 mf.

A comparative cost study on the construction of an underground garage for an administration building of a federal transportation administration as a combined shelter for a traffic control center and for the administrative personnel is reported. The shelter is to offer protection against the effects of nuclear weapon explosions (direct hits of conventional weapons are neglected) and for a planned occupancy of 500, 1000, and 1500 persons. The relationship is determined between cost, pressure resistance, and size of the multipurpose building. Costs do not increase proportionally with the pressure resistance and the relation is characterized by two clearly distinct ranges, a nonlinear range <3 atm and a linear range >3 atm. Small shelters were found to be substantially more expensive than large shelters but shelters for 3000 to 5000 persons are not advantageous from the standpoints of economy or protective function. (F.S.)

Radioactive Material Handling

Refer also to abstracts 25971 and 27849.

26133 (NYO-841-4) AIR CLEANING STUDIES PROGRESS REPORT, JULY 1, 1964–AUGUST 31, 1965. Viles, F. J.; Yoder, R. E.; Reist, P. C.; First, M. W. (Harvard Air Cleaning Lab., Boston, Mass.). Contract AT(30-1)-841. 114p. Dep. CFSTI.

Air-borne contaminants which are emitted from nuclear reactors during normal operations, or following an accident, may be highly radioactive and require a high order of reliable control to assure negligible exposures to operating personnel and the public. Although considerable progress has been made in defining the nature and state of these contaminants and suitable methods for their control, further research is required to develop more efficient and economical means of control for the varied conditions that may be encountered in practice. A brief review of problems and suggested areas for investigations associated with the removal of two principal contaminants (i.e., krypton-85 and iodine-131 and its compounds) from reactor atmospheres is given. Also included are brief discussions on electrostatically charged fluidized beds, application of the Pollak–Noland nucleus counter to routine air filter testing, Nerva propulsion gas cleaning, reactor coolant loss and fission product release from sodium fires, the LOFT program, and the Nuclear Safety Pilot Plant. (auth)

26134 STUDIES OF A CONTAINER FOR DISPOSING OF RADIOACTIVE WASTES INTO THE SEA. VI. ON THE PERMEABILITY AND DIFFUSION IN MORTAR (2). Sasaki, Tadayoshi (Tokyo Univ. Inst. of Physical and Chemical Research, Tokyo); Okazaki, Moriyoshi. Nippon Kaiyo Gakkaishi, 22: 245-54(Dec. 1966). (In Japanese).

The diffusion of solutes in mortar was investigated in a study of containers used for waste disposal at sea. In cases where concrete containers are deposited on the deep-sea floor, it was feared that radioactive waste may leak out through the pores of the concrete container. The diffusion coefficient and the coefficient of permeability of iodine-131 were determined for radioactive ions. The coefficients of diffusion and permeability of ^{131}I were almost the same as those for Cl as previously determined. Zinc-65 showed no evidence of diffusion even in porous mortars. This may be attributed to colloidization. In forcing $ZnCl_3$ solutions into pores of mortar, the pores were choked with $Zn(OH)_2$ colloid. (NSA of Japan)

26135 DEVELOPMENT OF FOAM PLASTIC AS HIGH TEMPERATURE INSULATION AND SHOCK ABSORBENT LINING FOR UF_6 PACKAGES. Mallett, A. J.; Wheatley, S. J. (Oak Ridge Gaseous Diffusion Plant, Tenn.). Contract W-7405-eng-26. Nucl. Eng. Design, 5: 98-106(Jan.-Feb. 1967).

New protective packages for uranium hexafluoride cylinders which have successfully passed the simulated accident tests described in the Atomic Energy Commission Manual Chapter 0529 were developed. These tests encompass conceivable accident conditions that could occur in transit. The packages, designed to protect cylinders of 5- to 30 in. diameter, incorporate a foam plastic lining that has superior heat insulation, cushioning, fire resistance, and neutron attenuation properties. (auth)

26136 CALCULATION OF THE SHIELD OF A SPENT-FUEL SHIPPING CONTAINER. I. Hoehn, J. (VEB Kombinat Kernenergetik, Berlin. Buero fuer Entwicklung und Projektierung Kerntechnischer Anlagen, Berlin). Kernenergie, 10: 14-20(Jan. 1967). (In German).

The shield of a shipping container for spent fuel elements was calculated. Depleted nuclear fuel (UO_2 enriched with ^{235}U) was stored for half a year in the storage tank after burnup in the reactor for two years. The calculation was based on doses at the surface of the container with consideration of international regulations. The complex geometry of shielding due to the design of the container was approximated physically in such a way that using an electronic computer for numerical evaluations is not necessary. (auth)

26137 OPTIMUM SIZE OF GAS FLOW COUNTERS FOR WATER SAMPLE COUNTING. Pusch, W. M. (Oesterreichische Studiengesellschaft fuer Atomenergie, Vienna). Atomkernenergie, 12: 193-8(May-June 1967). (In German).

A method for determining the optimum size of gas flow counters is described. Low activity waste water is evaporated and the activity of the remaining solids is then counted with a gas flow counter. The efficiency of gas flow counters is calculated based on the sample weight per unit area and from that the quality factor G as a function of total sample weight, β energy, and size of counter window or planchets. If a sample weight is known, the size of the window or the planchet dia which will give the shortest counting time may be determined from graphs which are included. (F.S.)

26138 MECHANICAL GAP TRANSFER PUMP. Lefrancois, Jacques (to Commissariat a l'Energie Atomique). British Patent 1,068,709. May 10, 1967. Priority date Oct. 29, 1964, France.

A mechanical transfer pump particularly adapted to the transfer of radioactive gases comprises a liquid piston moving in a compression chamber. The chamber has intake and delivery valves whose openings and closings are synchronized with the movement of the piston with the intake valve located on the axis of the delivery valve. The delivery valve is made up of a floating member, which is raised directly from its seating as a result of compression of the volume of gas produced by the movement of the liquid piston. A portion of the compression chamber containing the liquid piston is formed by a pair of bellows that are operable both to contract or both to expand together so as to ensure maximum liquid displacement in the chamber. (B.L.M.)

Vacuum Engineering

26139 (NP-tr-1523) TRAP WITH GETTER ELEMENTS FOR AN OIL DIFFUSION PUMP. Romanov, A. A. (Akademiya Nauk Ukrainskoi SSR, Kharkov. Fiziko-Tekhnicheskii Institut). Translated for Culham Lab., Eng., from report FTI-222/P-075. 12p. (CTO-353). Dep. mn. CFSTI $3.00 cy, $0.65 mn. JCL $1.60 fs, $0.80 mf.

To ensure a high vacuum free from traces of the working fluid used in the oil diffusion pumps, liquid nitrogen-cooled traps are commonly used. The use of liquid nitrogen has a number of disadvantages. On the other hand getter traps, using molecular screen type materials as sorbents, though not requiring liquid nitrogen cooling, have certain other serious disadvantages preventing their widespread use. Traps with getter elements which avoid all the disadvantages of existing getter traps were developed. Several requirements which the sorbent for such traps must fulfill are listed, and methods by which they can be met are indicated. (auth)

26140 VACUUM SEALING TECHNIQUES. Roth, A. New York, Pergamon Press, 1966. 857p.

Various techniques used in vacuum sealing are described. Basic welded, brazed, glass–glass, glass–metal, glass–ceramics, ceramic–metal, waxed, resin, silver chloride, soldered, ground, liquid, elastomer, and metal gasket vacuum seals are discussed. Specialized vacuum seals, e.g., lead—throughs, mechanical, magnetic, electric or heat actuated motion seals, cut-offs, stopcocks, values, gas leaks, vacuum locks, devices for opening containers under vacuum, windows, and self supporting films are also discussed. Design, fabrication, performance, and testing of seals are described. (R.C.K.)

26141 MATERIALS OF HIGH VACUUM TECHNOLOGY. VOLUME 1. METALS AND METALLOIDS. Espe, Werner. New York, Pergamon Press, 1966. 923p. $45.00.

Translation of Werkstoffkunde der Hochvakuumtechnik.

The materials used in high vacuum technology are discussed. Metallurgical properties, i.e., recrystallization, cold work hardening, ductility, creep limits, and the influence of impurities are described. The classes of materials discussed are: refractory metals and alloys; noble metals; base metals, alloys and composites of base metals, rare metals, other metals and carbon. The chemical, metallurgical, and physical properties of these materials are discussed from the ore dressing stage to final fabrication. (R.C.K.)

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstracts 26005, 26137, 26426, 26865, 27572, and 27574.

26142 (AERE-R-5419) COMPUTATION OF CERTAIN SOLID ANGLES AND SOME USEFUL ASSOCIATED FUNCTIONS. Ruffle, M. P. (Atomic Energy Research Establishment, Harwell (England)). Mar. 1967. 17p. Dep. CFSTI. HMSO 3s. 0d.

Formulas are presented for evaluating the solid angle subtended by a plane polygon and a circular disc at a general point in space. The averages of the latter function over a coaxial parallel disc are expressed in terms of standard elliptic integrals. The calculations were made in connection with determinations of the efficiency of nuclear particle detectors, as well as for other problems. (auth)

26143 (ANL-7220, pp 31-9) GEOMETRICAL AND PHYSICAL PARAMETERS IN WHOLE-BODY GAMMA-RAY SPECTROMETRY MEASUREMENTS. Marinelli, L. D. (Argonne National Lab., Ill.).

The spatial relation between subject and scintillation detector that would best serve the needs of radiation protection or clinical research is discussed. Topics include general calibration criteria; narrow angle systems such as the arc, Argonne chair, and collimated scan; and wide angle systems such as 4π counters, multicrystal arrays, and uncollimated scanning. (B.G.D.)

26144 (BNL-11313) 14-FOOT BUBBLE CHAMBER RESEARCH AND DEVELOPMENT PROGRAM: OVERALL PLAN AND OPTICS DETAILS. Louttit, R. I. (Brookhaven National Lab., Upton, N. Y.). Apr. 10, 1967. 18p. (CONF-670416-1). Dep. CFSTI.

From International Colloquium on Bubble Chambers Conference, Heidelberg, Germany.

The construction of a one-half linear scale model of the proposed BNL 14-foot bubble chamber is discussed. Topics discussed are the optical system, use of Scotchlite, and neon-hydrogen mixtures. (B.G.D.)

26145 (CONF-660722-1) ANALYSIS OF HIGH-ENERGY PHYSICS EXPERIMENTS IN LABORATORIES WITH NO MEASURING EQUIPMENT. Maglic, B. (European Organization for Nuclear Research, Geneva (Switzerland)). [1966]. 7p. Dep.

From International Conference on Cybernetics and Use of Computers, Hercegnovi, Yugoslavia.

Three proposals for analyzing high energy physics experiments in laboratories without measuring equipment are briefly described. The first method consists of renting an IBM card puncher and sending decks of cards to CERN where they would be processed and returned. The second proposal is to connect a computer in Paris directly to the experimental set-up in CERN via TELEX lines and thus participate in the CERN experiment in real time while remaining in Paris. According to the third proposal teams participate in the experiment and its preparation and then take home the magnetic tapes for analysis. (J.F.P.)

26146 (ECOM-2805) PORTABLE WIDE-RANGE RADIAC INSTRUMENT USING A SOLID-STATE ELECTROMETER. Healey, Gerald F. (Army Electronics Command, Fort Monmouth, N. J.). Feb. 1967. 16p. CFSTI.

A wide-range radiac instrument was developed to measure gamma radiation dose-rates from 1 mR/hr to 1000 R/hr, in six linear ranges. The circuit is a hybrid type using an ion chamber for the four high ranges of 0-1, 10, 100, 1000 R/hr, and a G-M tube, for the two low ranges 0-10, 100 mR/hr, contained in a detachable probe. An interesting feature of the circuit is the solid-state electrometer amplifier which uses insulated gate field-effect transistors in the input stage and its combination with a Geiger Mueller frisking probe to attain increased sensitivity. (auth)

26147 (IDO-17222) GAMMA-RAY SPECTROMETRY OF NEUTRON-DEFICIENT ISOTOPES. Annual Progress Report. Cline, J. E.; Heath, R. L. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Mar. 1967. Contract AT(10-1)-205. 67p. Dep. CFSTI.

The principal objective of this program continues to be the collection of pulse-height spectra representing the response of a laboratory gamma-ray spectrometer to individual neutron-deficient isotopes. The development of FET preamplifiers at the laboratory has made it possible to achieve an energy resolution of 750 eV for 100 keV gamma rays with Ge(Li) and less than 700 eV for low-energy x-rays using Si(Li) detectors. A new preamplifier was developed for general application to high-resolution spectrometry which permits the measurement of spectra at high counting rates with no deterioration in resolution, greatly enhancing the usefulness for applications which require high resolution. As a result of the interest in using solid-state detectors for x-ray spectrometry, considerable effort was expended in a study of the operating characteristics of Si(Li) systems for such applications. Factors which were investigated include detector operating temperature, source-detector geometry, and problems connected with field operation of spectrometer systems. Several commercial detectors have been studied and the results of these investigations are presented. Many uses of high resolution germanium systems for gamma-ray spectrometry are highly dependent upon the availability of precise values for the energies of the gamma rays emitted by each isotope. For this reason the measurement of energies for all gamma rays in catalogue spectra was undertaken. This made it necessary to study the linearity and stability of ADC systems and to develop methods for computer analysis of data because of the large volumes of data involved. Results to date are presented. During the past year, the major effort in the production of spectra for the Catalogue was concentrated on those isotopes produced by the (p,xn), (^{3}He,xn), (γ,p), and (γ,n) reactions. A large number of spectra were obtained with Ge(Li) detectors. Many of the nuclides studied have been of the short-lived species which are of particular interest in activation analysis studies using neutron generators. Plans for the publication of a supplement to the Sodium Iodide Spectrum Catalogue and a new Catalogue of Germanium Spectra are discussed. (auth)

26148 (INR-767/XIII/I) ISPOL'ZOVANIE SPEKTROMETRA S POLUPROVODNIKOVYM DETEKTOROM DLYA ISSLEDOVANIYA CHISTOTY α AKTIVNYKH IZOTOPOV. (The Application of Semiconductor Detector for Determination α Emitters Impurities). Kempistyi, T. (Institute of Nuclear Research, Warsaw (Poland)). 1966. 20p. (In Russian).

Research on semiconductor detector spectrometer applications to the purity determination of α radioisotopes was done and the results are presented. The influence of some parameters on the resolution is discussed. The silicon surface barrier detectors with active area of 10, 30, and 100 mm^2 was used in conjunction with a low noise charge sensitive preamplifier and channel Kicksorter Intertechnique type SA40. (auth)

26149 (INR-777/XIX/D) METHODE DE MESURE SIMULTANEE D'EQUIVALENT DE DOSE /DE/ ET DE FACTEUR DE QUALITE /QF/ DE LA RADIATION MIXTE. (Methods of Simultaneous Measurement of Dose Equivalent /DE/ and Quality Factor /QF/ of Mixed Radiation). Pszona, A.; Zielczynski, M.; Zarnowiecki, K. (Institute of Nuclear Research, Warsaw (Poland)). 1967. 16p. (In French). (CONF-660920-16). Dep.

From 1st International Congress of the International Radiation Protection Assn., Rome, Italy.

Dose equivalent (DE) and quality factor (QF) of any radiation or radiation mixture can be determined by means of two detectors. The sensitivity of one detector is linear against QF and without QF dependence of the second. The ions column recombination in tissue equivalent ionization chamber are used for DE and QF measurements. The scintillation DE and QF measurements methods are also reported. (auth)

26150 (MIT-2098-299, pp 35-51) HIGH ENERGY ACCELERATOR PHYSICS GROUP. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science).

Various photoproduction, meson-proton, meson (K^+) decay, and electron interactions are described. Also the development and use of computers, wire spark chambers, hodoscopes, other detectors and the external beam facilities at the CEA are discussed. (TSS)

26151 (NYO-3124-2) FABRICATION OF SEMICONDUCTOR DEVICES BY NEUTRON TRANSMUTATION DOPING. Annual Report. Klahr, Carl N.; Cohen, Melvin S. (Fundamental Methods Associates, New York). June 1966. Contract AT (30-1)-3124. 84p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The present status of a program for developing neutron transmutation doping in germanium and silicon for microcircuitry applications is summarized. Neutron transmutation doping produces electronically active impurities in germanium or silicon. The spatial pattern in which these impurity atoms are located is specified by a pattern of slits in a shielding material which is opaque to thermal neutrons, a radiation die. The radiation die permits neutrons to enter the selected regions, transmuting (for example) silicon nuclei to the dopant phosphorus. The experiments have demonstrated the predictability and reproducibility of the doping in germanium and silicon, with tolerances of 1 to 2 mils using thin radiation dies. Field-effect transistors suitable for microcircuit applications have been made and tested; interesting microcircuit configurations have also been doped by transmutation. (auth)

26152 (RT/EL-(67)2) TUBI CONTATORI A TRIFLUORURO DI BORO. **(Boron Trifluoride Counter Tubes). Cervellati, R.; Monaci, P.; Rispoli, B. (Comitato Nazionale Energia Nucleare, Rome (Italy)). 1967. 25p. (In Italian). Dep.**

Boron trifluoride proportional counters for the detection of thermal neutrons were made and their performance studied. The tubes have a copper cathode, typical sensitivities, and a very low background. A short outline of the technologies needed for the construction of the tubes and the gas purification is given. The characteristics of the detectors, having in mind possible improvements, are then discussed with special regard to the pulse spectrum as a function of the voltage supply and the parameters of the electronic chain. The absolute value of the collected electric charge per pulse is evaluated. The minimum value of the multiplication factor, which is still suitable for neutron counting, is also indicated. (auth)

26153 (SC-TM-67-268) BACKGROUND COMPENSATED PERSONNEL MONITOR. Ashworth, J. D. (Sandia Corp., Albuquerque, N. Mex.). May 1967. Contract AT(29-1)-789. 14p. Dep. CFSTI.

A new personnel monitor system was designed to work in areas of a varying background of radiation. It is a system that will detect abrupt changes in radiation while compensating for a variable background. This type of system is well suited to reactor facilities, where variable backgrounds are common. (auth)

26154 (SLAB-PUB-299) DISPLAY CONTROL OF A CRT-FILM SCANNING SYSTEM. Dickens, C. R. (Stanford Linear Accelerator Center, Calif.). Apr. 1967. Contract AT(04-3)-515. 4p. (CONF-670515-2). Dep. CFSTI.

From 8th National Symposium of the Society for Information Display, San Francisco, Calif.

The display control of a CRT-film scanning system for bubble chamber film in high-energy physics is discussed. (B.G.D.)

26155 (SLAC-PUB-300) SYSTEM DESIGN FOR CRT FILM SCANNING AND MEASURING. Miller, W. F.; Van der Lans, J. (Stanford Linear Accelerator Center, Calif.). Apr. 1967. Contract AT(04-3)-515. 9p. (CONF-670515-1). Dep. CFSTI.

From 8th National Symposium of the Society for Information Display, San Francisco, Calif.

Devices have been developed for digitizing spark-chamber and bubble-chamber films generated in high-energy physics experiments. The devices are connected to an IBM 360/50. A description is given of the spot generator, control and data transfer, and scanning and digitization. Finally, some of the differences between the digitizers (Hummingbird I and II) are discussed. (D.L.C.)

26156 (UCRL-50007-66-2, pp 1-6) PLUTONIUM SURVEY WITH X-RAY DETECTORS. Schmidt, C. T.; Koch, J. J. (California Univ., Livermore. Lawrence Radiation Lab.).

Experimental results indicate that a 5-in. by $^{1}/_{16}$-in. thick NaI(Tl) scintillation detector would be useful for the survey of plutonium contamination above 5–10 μgm/m^2 if the background level is known. (auth)

26157 (UCRL-50007-66-2, pp 7-12) ENERGY INDEPENDENT FOIL ACTIVATION SYSTEM FOR RAPID ASSESSMENT OF PULSED NEUTRON DOSE. Block, S. (California Univ., Livermore. Lawrence Radiation Lab.).

A simple technique for rapid assessment of neutron dose from prompt neutron exposure independent of particle fluence energy distribution is described. The technique consists of using an energy independent gold foil activation system. (B.G.D.)

26158 (UCRL-50007-66-2, pp 12-21) ACTIVATED SILVER PULSED NEUTRON DETECTOR. Zurakowski, P. R.; Lakin, R. W.; Barlow, O. M.; Taylor, R. D.; McCormick, L. T. (California Univ., Livermore. Lawrence Radiation Lab.).

An instrument was developed to be used with pulsed neutron sources that has the capability of measuring thermal flux, fast flux, REM dose, and possibly average energy. (auth)

25159 (UCRL-50007-66-2, pp 28-30) PROTON RECOIL TRACK COUNTING BY TELEVISION. Samardzich, B. G.; Kathren, R. L. (California Univ., Livermore. Lawrence Radiation Lab.).

Direct microscope counting of proton recoil tracks by closed-circuit television reduces counting time and minimizes eyestrain. (auth)

26160 (UCRL-50156) APPLICATIONS AND OPTIMIZATION OF THE LITHIUM-DRIFTED GERMANIUM DETECTOR SYSTEM. **Camp, David C. (California Univ., Livermore. Lawrence Radiation Lab.). Mar. 1, 1967. 102p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.**

The concept of semiconductors and how the semiconductor materials silicon and germanium are used as radiation detectors are discussed. The various types of lithium-drifted germanium detectors that have evolved are also discussed. Some of the requirements necessary if the detector and the electronic components that comprise the total system are to give the best possible performance are presented. The lithium-drifted germanium detector as a gamma-ray spectrometer and the various ways in which these detectors are being used are described. The reduction of germanium detector data using computers is evaluated. (auth)

26161 (UCRL-50228) IMPROVEMENTS IN THE SOLID-STATE PLUTONIUM-ALPHA AIR MONITOR. **Lindeken, C. L.; Lakin, R. W. (California Univ., Livermore. Lawrence Radiation Lab.). Apr. 19, 1967. Contract W-7405-eng-48. 11p. Dep. CFSTI.**

A fully transistorized plutonium-alpha air monitor based upon the use of a surface-barrier detector and a single-channel pulse-height analyzer is described. The monitor is designed for use in buildings having a central sampling system; it depends on this system or on an external air pump for its air flow. When the monitor is operated at 2 cfm, the detection sensitivity for the ^{239}Pu is 4 mpc-hours. This instrument is less expensive, more sensitive, and more compact than a previous model. (auth)

26162 ANALYSIS OF SIGNAL PULSE FROM SEMICONDUCTOR JUNCTION DETECTORS. Takeda, Seishi; Nishihara, Hiroshi (Kyoto Univ.). J. Nucl. Sci. Technol. (Tokyo), 4: 195-204 (Apr. 1967).

An elementary method of wave form analysis for semiconductor detectors under certain working conditions is derived from a simple model of pulse formation. Agreement of the calculation with the corresponding experimental results is satisfactory. The experiments were carried out on an M-8811-A-50 detector (TOSHIBA, 2,500 Ωcm, p-type Si). The load resistance was in the range 100 ~ 50,000 Ω. The amplitude and the rise-time were found to be in the ranges 1 ~ 6 mV and 3 ~ 9 ns, respectively. The energy spectrum of detector pulse for low load impedance extends up to 50 Mc. (auth)

26163 HIGH RESOLUTION Ge(Li) SPECTROMETER FOR HIGH INPUT RATES. Strauss, M. G.; Sherman, I. S.; Brenner, R.; Rudnick, S. J.; Larsen, R. N.; Mann, H. M. (Argonne National Lab., Ill.). Rev. Sci. Instrum., 38: 725-30(June 1967).

A system was developed for obtaining γ-ray spectra with high resolution at high input rates. For rates up to 100,000 γ-ray events/sec in a 3.5 cm^3 (13 mm thick) Ge(Li) detector, the FWHM at 1.33 MeV is 2–3½ keV and the spectral shift is no more than 0.1%. The amplifying chain, consisting of a cooled FET preamplifier and a simple main amplifier, is pole-zero compensated throughout. The amplifier produces unipolar pulses shaped with equal integrating and differentiating time constants of 1.2 μsec. The amplifier is followed by a two-diode baseline restorer, a pileup rejector, a linear gate, and an analog to digital converter. The salient features of the system are described and performance data are presented and discussed. (auth)

26164 ELIMINATION OF PHOSPHOR BACKSCATTERING EFFECT IN ELECTRON SCINTILLATION SPECTROMETRY. **Oda, Nobuo (Tokyo Inst. of Tech.); Suzuki, Hirosi. Jap. J. Appl. Phys., 6: 771-7(June 1967).**

Distortions of continuous electron spectra due to the effect of backscattering from phosphors in the scintillation spectrometer were studied experimentally for different shapes of plastic phosphors and different geometrical source-detector arrangements. Beta ray sources ^{32}P, ^{204}Tl, and ^{45}Ca were used for the test. Spectra obtained with sandwich- and well-type scintillators show the satisfactory spectral shape down to about two-tenths of the maximum energy due to the effective self-elimination of the backscattering effect. In particular the well type is applicable to all source-detector geometries. After making corrections for the effect of instrumental resolution, the values of the maximum energy were obtained with good accuracies. Even with a scintillator of the usual plane shape, the observed spectra show very little distortion, in the case of a well-collimated beam of normal incidence. (auth)

26165 STOPPING POWER RATIOS USED IN CAVITY IONIZATION CHAMBER. **Tomimasu, Takio; Sugiyama, Suguru (Electrotechnical Lab., Tokyo). Jap. J. Appl. Phys., 6: 788-9(June 1967).**

A modified formula of the mean mass stopping power ratio for high energy photons, including the photoelectric process, is shown and the mean mass stopping power ratios of carbon to air, aluminum to air, and copper to air are presented. (B.G.D.)

26166 INVESTIGATION OF HIGHLY HARDENED THERMAL NEUTRON SPECTRA USING NON-1/v ACTIVATION FOILS. **Albert, D. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie, 10: 78-84(Mar. 1967). (In German).**

Some experiments are described which were made using the non-1/v materials Lu, Eu, and ^{239}Pu in the center of comparatively high-absorbing spherical assemblies in the thermal column of the RFR reactor. The spectral indices resulting from these integral measurements are evaluated with respect to several spectrum parameters and are discussed. (auth)

26167 DEVICE FOR CONTINUOUS MEASURING OF CONCENTRATIONS OF RADIOACTIVE AEROSOLS. **Vydra, Milos (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Rez); Starcuk, Zenon. Jad. Energ., 13: 25-6(Jan. 1967). (In Czech).**

A device is described for continuous monitoring of long-life α-active aerosols. A coincidence method was used for compensating the short-life activity of naturally radioactive precipitates. (tr-auth)

26168 ANALYSIS OF GAMMA SPECTRA FROM EMITTER EMITTING MUTUALLY CLOSE ENERGIES. **Hrabovcova, Alejzia; Minarik, Frantisek (Research Inst. of Industrial Hygiene and Occupational Disease, Bratislava). Jad. Energ., 13: 20-3(Jan. 1967). (In Czech).**

The application of the G Doetsch method of decomposition of superpositions of normal frequency curves to complex photopeaks of scintillation γ spectra was studied. The method was used in Medgyessy approximation adjusted for approximate numerical computation. (tr-auth)

26169 COUNTER-RATIO SYSTEM FOR DETECTING HIGH ENERGY NEUTRON THRESHOLDS. **Brugger, R. M. (Phillips Petroleum Co., Idaho Falls, Idaho); Montague, J. H. Nucl. Instrum. Methods, 50: 229-36(1967).**

By improving the counter-ratio method of detecting (p,n) thresholds, ground state and excited state thresholds were detected up to proton energies of 9.5 and 10.2 MeV, respectively. Two arrangements of detectors were used; in one the customary counter-ratio detectors were modified so that the concentric cylindrical slow- and fast-neutron detectors had equal geometry; in the second arrangement, two slow-neutron detectors were used, which were, respectively, at 0 and 180° to the direction of the incident proton beam. The ratio of the counting rate of the "0°" detector to that of the "180°" detector showed the thresholds and corroborated the first counter-ratio method. The effectiveness of these two arrangements was demonstrated by detecting (p,n) thresholds in ^{27}Al, ^{58}Ni, ^{60}Ni and ^{54}Fe. (auth)

26170 PRECISION MEASUREMENT OF THERMAL NEUTRON BEAM DENSITIES USING A ^{3}He PROPORTIONAL COUNTER. **Als-Nielsen, J.; Bahnsen, A.; Brown, W. K. (Danish Atomic Energy Commission, Roskilde, Denmark). Nucl. Instrum. Methods, 50: 181-90(1967).**

A new method, based on the ^{3}He(n,p)T reaction, has been developed for the accurate determination of thermal neutron beam densities. Several comparisons were made with the conventional Au-foil activation method, and agreement was obtained between the two methods within an experimental uncertainty of ±0.4%. Fundamental advantages of the method include the 1/v dependence of the ^{3}He(n,p)T cross section up to 1 keV, and the assurance of homogeneity even for very small macroscopic cross sections, because of the gaseous detector material. Although the method requires a relatively clean neutron beam, it can be used over a wide range of neutron densities and, in particular, is capable of measuring extremely weak beams. A detector has been constructed with a well-defined efficiency and which is able to accept beams of diameters up to 10 cm. The ^{3}He counter method is proposed as a precision standard for the absolute measurement of thermal neutron beam densities. (auth)

26171 CORRECTIONS IN THE GOLD FOIL ACTIVATION METHOD FOR DETERMINATION OF NEUTRON BEAM DENSITY. **Als-Nielsen, J. (Danish Atomic Energy Commission, Roskilde, Denmark). Nucl. Instrum. Methods, 50: 191-6(1967).**

A finite foil thickness and deviation in the cross section from the 1/v law imply corrections in the determination of neutron beam densities by means of foil activation. These corrections, which depend on the neutron velocity distribution, were examined in general and are given in a specific example for a reactor beam transmitted through a 30 cm Bi filter. The effective cross section differs 0.5% from the capture cross section at 2200 m/s. For a 20 mg/cm^{2} Au foil the correction for beam attenuation and hardening through the foil is 0.7% and the activity correction is 1.5%. (auth)

26172 A METHOD FOR THE EVALUATION OF THE DOSE-SENSITIVITY OF GM COUNTERS AS FUNCTION OF THE ENERGY. **Polly, P. (Inst. of Electronics, Seibersdorf, Austria). Nucl. Instrum. Methods, 50: 197-208(1967).**

A method for the evaluation of the dose-sensitivity of GM-counters as function of the energy was developed. The measurements were performed in a collimated gamma-beam. To establish electron equilibrium the tubes were enveloped with cylindrical graphite-absorbers. The dose was measured with ionization-chambers with air-equivalent walls. Measurements for the evaluation of the influence of scattered-radiation and of other disturbing effects were performed and appropriate correction-factors calculated. The method was tested on the types Philips 18503, 18504, 18509, 18522, 18529 and 18550 (five tubes of each type), the dose-sensitivity of these tubes was evaluated. The results are presented in graphical form. (auth)

26173 SOME EFFECTS OF HEATING AND DRYING ON THE PROPERTIES OF NUCLEAR EMULSIONS. **Dyer, J. N. (Naval Postgraduate School, Monterey, Calif.); Heckman, H. H. Contracts W-7405-eng-48; NAS 9-5249. Nucl. Instrum. Methods, 50: 292-8(1967). (UCRL-17229).**

Some effects of heating and drying Ilford types G and K emulsions prior to exposure and processing are reported. It was found that some gain in sensitivity was obtained, but that an increase in "fog" background offset any advantage. For each emulsion type there is a critical temperature above which the growth of fog background soon makes the emulsion useless. Attempts to remove this fog by eradication showed that track images are removed more easily than the fog, so that the usefulness of emulsions which have been heated too much cannot be regained. No changes in the sensitivity of emulsions to near-minimum ionizing particles were observed between −20 and 50°C. (auth)

26174 NEW DETECTOR FOR NEUTRON CAPTURE CROSS SECTION MEASUREMENTS. **Weigmann, H.; Carraro, G.; Boeckhoff, K. H. (EURATOM, Geel, Belg.). Nucl. Instrum. Methods, 50: 265-9(1967).**

A new detector for neutron radiative capture cross section measurements is proposed, the efficiency of which is 4 times that of the conventional Moxon-Rae detector. Principally, it consists of 6 equally thick plastic scintillator sheets which are alternatively connected to 2 photomultipliers operating in coincidence. The efficiency of the detector is proved to have a linear dependence on γ-ray energy. Some preliminary data on radiative neutron capture in natural Mo obtained with this detector are presented. (auth)

26175 MULTI-ANGLE FAST NEUTRON TIME-OF-FLIGHT SYSTEM. **Smith, A. B.; Guenther, P.; Larsen, R.; Nelson, C.; Walker, P.; Whalen, J. F. (Argonne National Lab., Ill.). Nucl. Instrum. Methods, 50: 277-91(1967).**

A multi-angle fast neutron time-of-flight system operating in the nsec range is described. The system consists of: a.) up to ten simultaneously operational detectors situated at scattering angles of 20° to 150° and at flight paths of 1.5 to 3.5 m; b.) analog circuit components inclusive of time-to-pulse height converters and neutron-gamma-ray discriminators; c.) information routing and gating circuitry; d.) multi-dimensional analog to digital conversion apparatus; e.) a dual digital computer configuration and f.) a pulsed and bunched Van de Graaff accelerator. The system concept, components, operation including on-line information storage, processing, automated control, and off-line data processing are discussed. Examples of representative experimental applications are given. (auth)

26176 REGROWN p^{+} CONTACT FOR LITHIUM-DRIFTED GERMANIUM GAMMA-RAY DETECTORS. **Mooney, J. B. (Varian Associates, Palo Alto, Calif.). Nucl. Instrum. Methods, 50: 242-4(1967).**

A method for applying regrown Ga-In contacts to lithium-drifted germanium gamma-ray detectors, either before or after drifting, has been developed. Since alloying of the regrown contact and lithium diffusion can be accomplished during the same temperature cycle, it is possible to rearrange contacts and thereby construct thin, deep, low-capacitance detectors from large-area shallow ones. These in turn can be combined in one package to make deep, large volume-detectors. (auth)

26177 ROTATING CRYSTAL SPECTROMETERS WITH AND WITHOUT AN AUXILIARY DEVICE FOR SUPPRESSION OF UNWANTED REFLEXIONS. **Quittner, G.; Legler, E. (Oesterreichische Studiengesellschaft fuer Atomenergie GmbH, Seibersdorf, Austria). Contract 61(052)-638. Nucl. Instrum. Methods, 50: 251-7(1967).**

Unwanted reflections—higher order and parasitic—appear in the rotating crystal spectrometer when comparatively low primary energies are used. Inexpensive measures which are effective against parasitics are described. If these measures are applied and about half of each time-of-flight frame is reserved for higher orders the range of the spectrometer can be extended toward lower primary energies. Three types of devices for suppression of unwanted reflections are compared. The phased Fermi chopper has important advantages over the two others. The potential gains to be expected from the use of such a device are increase in intensity, reduction in background and more freedom in the choice of the primary energy and of the reflecting plane. The actual gain depends on several factors, including both external conditions and the fulfillment of certain design requirements. These factors should be weighted against the relatively high costs that must be put into development and construction of a device of this kind. (auth)

26178 A THRESHOLD GAS CHERENKOV COUNTER WITH LARGE SOLID ANGLE. **Dobbs, J. MacG. (Univ. of Pennsylvania, Philadelphia); McFarlane, W. K.; Yount, D. Nucl. Instrum. Methods, 50: 237-41(1967). (PPAD-586-E).**

A threshold gas Cherenkov counter to be used with a spark chamber momentum spectrometer is described. The angular acceptance of the counter is 60° × 13° at the entrance window of the counter, which is 30 cm × 20 cm. A uniform efficiency of 97% is obtained with sulfur hexafluoride at 7.45 bar (90 psi absolute), for 150 MeV/c electrons. (auth)

26179 ALPHA M: AN IMPROVED COMPUTER PROGRAM FOR DETERMINING RADIOISOTOPES BY LEAST-SQUARES RESOLUTION OF THE GAMMA-RAY SPECTRA. **Schonfeld, E. (Oak Ridge National Lab., Tenn.). Nucl. Instrum. Methods, 52: 177-8(June 1967). (ORNL-P-2426).**

Alpha M is an improved version of program Alpha—more versatile, more accurate, and also reduces the cost per determination. Fewer counts per channel are required, variations of the background are compensated for, computation time is reduced, results of consecutive spectra can be added, and initial conditions can be changed. A further improvement over Alpha is that the new program includes instructions for use with FORTRAN II, 62, 63, and IV languages and several digital computers–CDC-1604, -3600, IBM-7094/0, and -360. An instruction manual and Alpha M (with two sample problems) are available. (auth)

26180 STATISTICS OF ELECTRON MULTIPLICATION IN PROPORTIONAL COUNTERS. **Carver, J. H.; Mitchell, P. (Univ. of Adelaide). Nucl. Instrum. Methods, 52: 130-40(June 1967).**

Pulse spectra produced by the release of single primary electrons in a proportional counter were determined for a variety of gas fillings. The spectra were recorded with sufficient statistical accuracy to define their logarithmic derivatives in order to investigate deviations from the approximately exponential distributions. Two main effects were observed: (1) at small pulse heights there may be a reduced number of pulses compared with the exponential distribution if the electron multiplication commences in a region of low field strength; (2) at large pulse heights there may be an excess of pulses owing to the occurrence of secondary successor avalanches initiated by photoelectric effects. A theoretical distribution was derived which describes both these effects in terms of two parameters, one of which is characteristic of the ionizing efficiency of the electron at the commencement of the multiplication process while the other is a measure of the mean number of successors per avalanche. These parameters were determined for each of the observed spectra. (auth)

26181 END-WINDOW COUNTING OF TRITIUM RADIOACTIVITY BY SCINTILLATION PHOSPHOR COMBINED WITH PRISMATIC LIGHT GUIDE. **Muramatsu, M.; Tokunaga, N.; Koyano, A. (Tokyo Metropolitan Univ. Japan Radiation and Medical Electronics, Inc., Tokyo). Nucl. Instrum. Methods, 52: 148-52(June 1967).**

End-window counting has been achieved with a scintillation probe wherein a sheet of scintillator phosphor is combined with a prismatic light guide for dividing and transmitting the optical scintillae into two photomultiplier tubes, which lead to a coincidence circuit for counting the tritium radioactivity with eliminating the thermal noises. The probe has proven to enable us to measure reliably, easily and rapidly radioactivities of tritiated specimens at any temperature, regardless of their size, shape, physical state and chemical forms. (auth)

26182 GAMMA-RAY ATTENUATION COEFFICIENTS FOR GERMANIUM. **Chapman, G. T. (Oak Ridge National Lab., Tenn.). Nucl. Instrum. Methods, 52: 101-3(June 1967).**

An interpolation method based on the values listed in NBS-583 for five elements adjacent to germanium was used to determine the gamma-ray attenuation coefficients of germanium. If the region of the atomic numbers, Z, is relatively small and the gamma-ray energy is not too close to the K-shell energies for the elements in this range of Z, the attenuation coefficients will vary smoothly and not too drastically as a function of Z. (auth)

26183 LOW-LEVEL GAS COUNTER WITH A PLASTIC SCINTILLATOR AS ANTICOINCIDENCE SHIELD. **Huber, B.; Heinrich, F.; Von Buttlar, H. (Technische Hochschule, Darmstadt, Ger.). Nucl. Instrum. Methods, 52: 104-8(June 1967).**

The construction of a low-level counter is described, the wall of which is made of plastic material serving as the anticoincidence shield. Its background characteristics with ethane filling gas and its counting efficiencies for tritium and ^{14}C radiation are given. The performance of the counter compares favorably with existing designs. For tritium counting, the background is 1.7 cpm at an ethane pressure of 750 mm Hg and a sensitive volume of 1.5 liter. For ^{14}C counting, the background is 2.7 cpm; a 40,000 y old ^{14}C sample will produce 0.1 cpm. The memory effect due to the solubility of ethane in the plastic material is small. (auth)

26184 ANALYSIS OF GAMMA-RAY SPECTRA OBTAINED WITH A NaI(Tl) SCINTILLATION SPECTROMETER BY A TECHNIQUE WHICH TAKES ACCOUNT OF COINCIDENCE SUMMING. **Bradford, G.; Galloway, R. B.; Sillitto, R. M.; Vass, D. G. (Univ. of Edinburgh). Nucl. Instrum. Methods, 52: 93-100 (June 1967).**

A technique is described for analyzing a pulse-height spectrum from a NaI(Tl) scintillation spectrometer placed close to a source emitting cascades of γ rays, using the line shapes associated with each γ ray cascade. Each cascade line shape is constructed using the line shapes appropriate to the component γ rays (obtained by an energy interpolation technique from the line shapes for monoenergetic γ rays emitted from calibration sources) and the coincidence-sum shapes which result when a pair of γ rays in the cascade are detected simultaneously in the NaI(Tl) crystal. A practical method of calculating the coincidence-sum distribution due to two γ rays is discussed with reference to the γ rays from a ^{60}Co source. The pulse height spectrum due to the detection in a NaI(Tl) crystal 5" dia. by 4" long of the γ rays from the 3.58 MeV level in ^{10}B was obtained using a n-γ coincidence time-of-flight spectrometer to study the ^{9}Be(d,nγ)^{10}B reaction, and this spectrum is analyzed using cascade line shapes. (auth)

26185 LEAST-SQUARE-ERROR AMPLITUDE MEASUREMENT OF PULSE SIGNALS IN PRESENCE OF NOISE. **Radeka, V.; Karlovac, N. (Inst. Ruder Boskovic, Zagreb). Nucl. Instrum. Methods, 52: 86-92(June 1967).**

An attempt is made to provide an insight into the mechanism of optimum amplitude measurement of pulse signals, in particular nuclear detector signals, with the purpose of summarizing the results and indicating the approach to the remaining problems. It is recalled that the optimum way to perform amplitudes measurements in the presence of additive white gaussian noise— according to the least-square-error criterion—is to perform the "weighting" on the observed signal by evaluating the integral $g_m = \int_{-\infty}^{\infty} s_m(t) \cdot f(t)dt$, where $s_m(t)$ is the observed signal plus noise and f(t) is the expected signal waveform. It is shown that this relation follows from both the matched filter approach (linear circuit theory) and from the statistical estimation theory. The optimum operation can be performed by two methods: the matched filter measurement and the correlation measurement. The resulting best signal-to-noise ratio is invariant of the method and is equal simply to the ratio of the signal energy in the measurement time interval and the noise power density. This gives directly the relationship between the signal-to-noise ratio and the measurement time. The time invariant matched filter and its approximations presently in use are very inefficient with respect to the ratio of the measurement time actually required to extract the amplitude information and the time in which they are unable to perform another measurement. This is a basic limitation of time-invariant linear filters. The solution to optimization of both the signal-to-noise ratio and the time requires time variant filters. (auth)

26186 METHOD FOR RESOLUTION CORRECTION AND SHAPE FACTOR ANALYSIS OF BETA SPECTRA. **Willett, J. B.; Spejewski, E. H. (Indiana Univ., Bloomington). Nucl. Instrum. Methods, 52: 77-85(June 1967).**

A procedure for precision fitting of resolution distorted beta spectra, using shape factor parameterization, is described. A derivation of the fitting function is made, and a method for decoupling the fitting parameters is discussed. This decoupling allows the spectrum intensity, endpoint, and shape factor parameters to be determined with a high degree of precision. This method is applicable to multigroup spectra with components having an arbitrary degree of forbiddenness, unique or nonunique. Included is a description of a computer program which is designed to use this method in the analysis of spectra measured with a 4π semiconductor spectrometer. Numerous methods of least squares minimization have been tried, and two methods of error analysis are discussed. Some results from the analysis of ^{36}Cl, ^{143}Pr, ^{185}W are given. (auth)

26187 THE ^{3}He COUNTER AS A DETECTOR FOR TIME-OF-FLIGHT MEASUREMENTS OF THERMAL NEUTRON SPECTRA. Heiberg, E. (Instituut for Atomenergi, Kjeller, Norway). Nucl. Instrum. Methods, 52: 175-6(June 1967).

A continuation is made of a comparison between a BF_3 detector and a boron loaded scintillator for time-of-flight measurements of thermal reactor spectra, using a straight slit chopper. Because the ^{3}He counter is sensitive to gamma radiation, it combines the positive features of both the BF_3 counter and the boron loaded scintillator, as the time-zero is automatically given by the half-width of the chopped gamma beam recorded on e.g., a multichannel analyzer. (auth)

26188 SPUTTERED BORON FILMS ON SILICON SURFACE BARRIER DETECTORS. Rose, A. (Australian Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Nucl. Instrum. Methods, 52: 166-70(June 1967).

Neutron detectors were prepared by sputtering ^{10}B directly on to the sensitive surface of silicon surface barrier detectors using low energy argon ions. A description of the sputtering system is given and comparisons are made between the sputtered detectors and conventional BF_3 counters. Sputtering rates of the order of 100 Å/min for boron were achieved. (auth)

26189 FAST TIME-OF-FLIGHT SPECTROMETER. Beckman, L.; Hansen, J.; Jansson, R. (Research Inst. of National Defence, Stockholm). Nucl. Instrum. Methods, 52: 157-62(June 1967).

The properties of a fast time-of-flight spectrometer using a bunched Van de Graaff accelerator and fast scintillation detectors are discussed. The electronic circuits which are essential for the time resolution are described. By using γ-radiation the shortest time resolution of the spectrometer was measured to 1.1 ns (fwhm). The corresponding energy spread in the proton beam has been calculated to ±4% at 1.9 MeV. (auth)

26190 COMPUTER-CONTROLLED FLYING SPOT DIGITIZER FOR SPARK CHAMBER PHOTOGRAPHS. Scharff-Hansen, P. (CERN, Geneva); Willitts, T. R.; Lacotte, J.-C.; Victor, C. Nucl. Instrum. Methods, 52: 25-8(June 1967).

A device is described which measures spark chamber pictures automatically at a rate of 1800/h, using any small computer of at least 2K memory. It has already been used to measure 500,000 pictures in three experiments. (auth)

26191 RESPONSE OF SELECTED NEUTRON MONITORING INSTRUMENTS TO SEVERAL TYPES OF NEUTRON SOURCES. Hankins, Dale E. (Los Alamos Scientific Lab., N. Mex.). Health Phys., 13: 587-92(June 1967).

Several types of neutron sources which can be used for calibrating neutron-monitoring instruments have recently become available. Some of these sources utilize the alpha-neutron reaction, and have neutron spectra which are reported to be reasonably similar. The response of several neutron-monitoring instruments to nine neutron sources are composed and it is concluded that differences in the neutron spectra of the sources, and differences in the energy dependence of the instruments, significantly affect calibration results. Neutron sources of ^{238}PuBe, ^{239}PuBe, AmBe, PoBe, RaBe, and spontaneous fissioning ^{244}Cm were used. The sources were calibrated in the Los Alamos Scientific Laboratory's standard pile with a probable error of ±5 per cent for the reported absolute source strength, and a probable error of ±3 per cent for the comparison made in this study. The instruments used were the Hurst absolute fast-neutron dosimeter, the Ludlum Model 11 neutron detector, the Eberline portable neutron counter (PNC), the Eberline FNIA fast-neutron detector (scintillator), the 10-in., single-sphere neutron-monitoring instrument, and the 8-, 3- and 2-in. spheres of the multisphere technique. The data from each instrument were recorded by using a 100-channel pulse-height analyzer. The results indicate that all the instruments show essentially the same response to the ^{238}PuBe, AmBe, and PoBe neutron sources. The moderated BF_3 instruments show a high response (~14 per cent) to the ^{239}PuBe and RaBe sources, and also a high response (~38 per cent) to the ^{244}Cm. The fast-neutron scintillator had a response 58 per cent low to the ^{244}Cm. The ^{239}PuBe sources have a larger low-energy neutron component than the ^{238}PuBe, AmBe and PoBe sources. The largest ^{239}PuBe source and the ^{244}Cm source showed low readings of 9 and 26 per cent with the Hurst neutron dosimeter. The large ^{239}PuBe source was found to be anisotropic by ~30 per cent. These variations should be recognized and considered in the calibration of neutron-monitoring instruments. (auth)

26192 SIMPLE NEUTRON MONITOR. Finckh, E.; Weidinger, A. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Kerntechnik, 9: 73-4(Feb. 1967). (In German).

A neutron monitor for the continuous monitoring of the radiation peaks of a Van de Graaff 5.5-MeV accelerator was constructed. The results obtained for two dimensions of the paraffin blocks in which the BF_3 counter was inserted were reported. (J.S.R.)

26193 FAST NEUTRON DOSE RATE MEASUREMENT WITH SEMICONDUCTOR DETECTORS. Deme, S. (Central Research Inst. for Physics, Budapest). pp 29-36 of Proceedings of the Second Symposium on Health Physics. Vol. I. Budapest, Publishing Group of the Central Research Institute for Physics, 1966.

See CONF-660948-(Vol.1).

Investigations of the conditions under which silicon semiconductor detectors can be used for the measurement of fast neutron tissue doses are described. It is shown that dose rate measurements cannot be performed on basis of the Bragg–Gray principle. The possibility of adopting the generalized dosimetric principle proposed by Hurst and Ritchie is studied. A digital computer was used for the evaluation of the energy spectra of recoil protons from thick radiator incident on sensitive layers of various depths. The computed energy dependences of the dosimetric system are presented. For the experimental investigations 75- or 100-μ thick surface barrier dE/dx-type silicon detector and thick polyethylene radiator setup as used. The energy response was measured using monoenergetic neutrons with energies from 2 to 5 MeV and the disturbing gamma interference established with ^{60}Co source. Finally some possible applications of the dosimetric system are suggested. (auth)

26194 EXPERIMENTAL METHODS FOR THE TESTING OF AIR EQUIVALENCE CONDITIONS OF IONIZATION CHAMBER WALL MATERIALS. Hizo, J. (National Office of Measures, Budapest). pp 37-40 of Proceedings of the Second Symposium on Health Physics. Vol. I. Budapest, Publishing Group of the Central Research Institute for Physics, 1966.

See CONF-660948-(Vol.1).

Two methods of high sensitivity for the testing of the deviation from air equivalence of solid ionization chamber wall materials are discussed. With one method the electrodes of the ionization chamber were made of the test material, while with the other, samples of the test material are placed in a free-air chamber. (auth)

26195 TRANSFER MEASURING EQUIPMENT FOR THE COMPARISON OF R STANDARDS IN A WIDE ENERGY RANGE. Zsdanszky, K.; Hizo, J.; Peter, M. (National Office of Measures, Budapest). pp 41-4 of Proceedings of the Second Symposium on Health Physics. Vol. I. Budapest, Publishing Group of the Central Research Institute for Physics, 1966.

See CONF-660948-(Vol.1).

The principle of a high-accuracy dosimetric equipment incorporating a special ionization chamber and designed in the first line for the comparison of R standards in a wide energy range on an international level is discussed. Fitted out with several chambers of various sizes the equipment is used for other dosimetric purposes as a secondary standard. (auth)

26196 BETA DOSE RATE MEASUREMENT WITH SILICON COUNTER. Roman, J.; Sawicka, B. (Central Lab. on Radiological Protection, Warsaw). pp 45-9 of Proceedings of the Second Symposium on Health Physics. Vol. I. Budapest, Publishing Group of the Central Research Institute for Physics, 1966.

See CONF-660948-(Vol.1).

The use of silicon surface-barrier detector as an extrapolation parallel plate ionization chamber, in measuring of beta radiation dose rate was investigated. The detector response was compared to the surface absorbed dose rate in tissue, measured with an extrapolation air ionization chamber. It was found that the correlation is sufficiently good and that the extrapolation silicon counter is suitable for use under laboratory, as well as field conditions. The beta radiation dose rate range from few milirads to about few hundred rads can be covered. (auth)

26197 QUALITATIVE AND QUANTITATIVE IDENTIFICATION OF BETA RAY EMITTERS USING SILICON COUNTERS. Dabrowski, A. (Central Lab. on Radiological Protection, Warsaw); Jagusztyn, M.; Roman, J.; Slapa, M.; Przyborski, W. pp 51-5 of Proceedings of the Second Symposium on Health Physics. Vol. I. Budapest, Publishing Group of the Central Research Institute for Physics, 1966.

See CONF-660948-(Vol.1).

Silicon surface-barrier and Li-drift counters were constructed, and used for qualitative and quantitative identification of beta ray emitters. The energy resolution measured at room temperature was of about 8 keV (fwhm) for 625 keV (ICE). The consideration was given to low background counting. An anticoincidence counter was constructed with the background count, in the energy range between 10 keV and 3 MeV, less than 0.3 cpm per cm^2. (auth)

26198 PORTABLE SCINTILLATION TYPE WEAK BETA CONTAMINATION METER. Payer, K.; Vasvari, G. (Central Research Inst. for Chemistry, Budapest). pp 81-5 of Proceedings of the Second Symposium on Health Physics. Vol. I. Budapest, Publishing Group of the Central Research Institute for Physics, 1966.

See CONF-660948-(Vol.1).

A portable transistorized contamination meter was constructed for measuring weak beta and gamma radiations. The contamination meter consists of two units, the detector unit including the preamplifier and the main unit containing main amplifier, pulse shaping circuit, integrating stage, stabilized hv power supply, lv stabilizer and batteries or lv power supply. The lowest detectable radioactive contamination is 3.10^{-4} μCi/cm^2 for weak beta and $1,5.10^{-3}$ μCi/cm^2 for gamma radiations. (auth)

26199 METHOD PROBLEMS FOR THE DETERMINATION OF LOW RADIUM CONCENTRATIONS USING SCINTILLATION CHAMBERS. Hoehle, R.; Schuh, U. (Inst. for Applied Radioactivity, Leipzig). pp 105-9 of Proceedings of the Second Symposium on Health Physics. Vol. I. Budapest, Publishing Group of the Central Research Institute for Physics, 1966.

See CONF-660948-(Vol.1).

The procedure of determining the concentration of radon, without using an absorber, of samples containing radium is discussed. According to this method the gas-volume required for removing the concentrated radon into the detector can be kept low, whereby a little measuring volume will be sufficient by using a scintillation chamber. From this a smaller background results and therefore a higher sensitivity is reached. In connection with the increasing of sensitivity problems of stability of the equipment and reproduction of the measuring effects were investigated. (auth)

26200 SOME EXPERIENCE WITH THE SCINTILLATION METHOD OF ^{222}Rn DETERMINATION. Wardaszko, T. (Central Lab. for Radiological Protection, Warsaw). pp 111-15 of Proceedings of the Second Symposium on Health Physics. Vol. I. Budapest, Publishing Group of the Central Research Institute for Physics, 1966.

See CONF-660948-(Vol.1).

There exist two basic ways of measuring ^{222}Rn content in air by means of scintillation devices, the use of chambers internally coated with a ZnS scintillator and electrostatic precipitation of radon daughters on a small ZnS-coated electrode with a subsequent alpha count. The first was used for systematic radon concentration measurements in air, as well as for other determinations. The detection limits of the method were 0.9 pCi and 4.10^{-2} pCi per sample respectively. Other parameters of the systems used and the accuracy of the method are discussed. (auth)

26201 THE FIRST WHOLE-BODY COUNTER IN THE GDR: DESIGN AND FIRST CALIBRATIONS. Poulheim, K.-F.; Loessner, V. (Inst. of Applied Radioactivity, Leipzig). pp 157-61 of Proceedings of the Second Symposium on Health Physics. Vol. I. Budapest, Publishing Group of the Central Research Institute for Physics, 1966.

See CONF-660948-(Vol.1).

The design and application of the first whole-body counter in the GDR is discussed. A suitable new shielding material, gypsum, is used. The whole-body counter was calibrated for potassium Cs-137, Ra-226, and Sr-90. Determinations of the Cs-137 values in 20 persons are performed periodically. The results are reported. In order to determine the activity induced by criticality accidents, the whole-body counter has been calibrated for Na-24 by means of phantom measurements. An international comparison of the determinations of the potassium and Cs-137 contents for several persons is reported. (auth)

26202 ANTHROPOGAMMAMETRY IN THE ENERGY RANGE 10 TO 100 keV. Jockey, P.; Ronteix, C.; Durand, F. Bull. Inform. Sci. Tech. (Paris), No. 113, 89-96(Mar. 1967). (In French).

Description and performances of thin (6.35 mm) NaI (Tl) detector of large diameter (200 mm) for anthropogammametry in the 10 to 100 keV energy range are given. Application in the case of iodine 125 and plutonium 239 is also shown. (auth)

26203 SILICON RADIATION DETECTORS AND SOME SIMPLE APPLICATIONS. Williams, I. R. (Oak Ridge National Lab., Tenn. Wantage Radiation Lab., Eng.). Phys. Educ., 2: 94-9(Mar. 1967). (ORNL-P-2376).

The semiconductor detector of ionizing radiations is rapidly becoming standard equipment in nuclear physics research experiments. The devices have many advantages the most important of which is that they can be used in spectrometers. The elementary physics of their operation is outlined, together with the techniques involved in their use. Details are also given of some student laboratory experiments that were performed with silicon detectors in order to demonstrate certain aspects of nuclear and solid-state physics. (auth)

26204 A COOLED FET PREAMPLIFIER FOR SEMICONDUCTOR DETECTORS. Kumahara, Tadashi; Shingai, Sadanori; Gotoh, Hiroshi; Sakai, Eiji (Japan Atomic Energy Research Inst., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 4: 152-4(Mar. 1967).

Measured characteristics of a number of preamplifiers constructed with four FET's connected in parallel in the input stage are presented along with some remarks which might be helpful in constructing preamplifiers. (B.G.D.)

26205 METHODS IN COMPUTATIONAL PHYSICS. ADVANCES IN RESEARCH AND APPLICATIONS. VOLUME 5. NUCLEAR PARTICLE KINEMATICS. Alder, Berni; Fernbach, Sidney; Rotenberg, Manuel (eds.). New York, Academic Press, 1966. 275p. $11.50.

Included in the discussion of computation methods for high energy physics are automatic retrieval spark chambers, computer-based data analysis systems, programing for the PEPR system, a system for the analysis of bubble chamber film based on the scanning and measuring projector, and a software approach to automatic scanning of digitized bubble chamber photographs. (J.F.P.)

26206 METHOD AND APPARATUS FOR THE PRODUCTION OF SEMICONDUCTOR LITHIUM-ION DRIFT DIODES. Tavendale, A. J. (to Atomic Energy of Canada Ltd.). Canadian Patent 752,583. Feb. 7, 1967.

A method is described for producing lithium-drifted germanium diodes. A thin layer of lithium is applied to one face of a slab of germanium crystal to form a P-N junction, followed by heating in a liquid such as chloroform, whose boiling point is 50–70°C. About 200 volts dc across the junction causes lithium ions to drift into the germanium to form a wide intrinsic layer of 5 mm thickness in ten days. Intermittent operation enhances the drifting process. (F.S.A.)

26207 IMPROVEMENTS IN NEUTRON FLUX DETECTORS. (to Atomic Energy of Canada Ltd.). British Patent 1,068,975. May 17, 1967. Priority date Dec. 28, 1965, United States.

A self-powered neutron detector is described which comprises a conducting or semiconducting emitter of cobalt-59 which spontaneously emits energetic electrons following the absorption of neutrons, a conducting collector which produces few electrons in a neutron flux compared to the emitter, a solid dielectric capable of retaining high electric resistivity when continuously exposed to intense radiation fields, a method for connecting the emitter and collector to a load resistance which is used to measure the intensity of the neutron flux. (B.G.D.)

26208 DEVICE FOR MEASURING THE RADIOACTIVITY OF WATER. Courtois, Andre; Grauby, Andre; Laporte, Augustin (to Commissariat a l'Energie Atomique). British Patent 1,067,396. May 3, 1967. Priority date Aug. 12, 1964, France.

A device for measuring the radioactivity of water is described. The characteristics of the device are immersibility, radiation detector (scintillation or Geiger–Mueller), programmer, memory, and magnetic recorder. (B.G.D.)

26209 IMPROVEMENT TO SCINTILLATION SPECTROGRAPHS AND SPECTROMETERS. (to Quartz and Silice). British Patent 1,067,053. Apr. 26, 1967. Priority date Apr. 16, 1964, France.

A scintillation spectrometer is described which incorporates a radioactive reference source consisting of a metal disc on which is disposed an alpha emitting source having a long half-life. This radioactive source is linked to a scintillating pellet optically coupled to the main scintillator. (B.G.D.)

Radiation Dosimeters

26210 (ANL-7220, pp 23-7) THERMOLUMINESCENT DOSIMETRY OF INTERNAL BETA-RAY EMITTERS. Kastner, Jacob; Oltman, B. G.; Dayal, Yogeshwar (Argonne National Lab., Ill.).

Investigation of the thermoluminescent response to beta rays of powders and single crystals of LiF and CuF$_2$ is reported. It is shown that there is no nonthermoluminescent or dead surface layer. It is demonstrated, also, that the thermoluminescent response is essentially proportional to the total energy deposited in the thermoluminescence system, irrespective of the beta-ray energies involved. There is clearly no specific ionization effect even with beta rays as soft as those from tritium, although care must be taken to consider potential static charge effects. (B.G.D.)

26211 (ANL-7220, pp 27-9) UV LASER EXCITATION FOR ULTRASENSITIVE PHOTOLUMINESCENT DOSIMETRY. Kastner, Jacob; Eggenberger, D. N.; Longnecker, A. A.; King, David; Schutt, Dale (Argonne National Lab., Ill.).

The use of an UV laser for excitation of luminescent dosimeters is discussed. Using this type of excitation with a sensing photomultiplier delayed electronically to prevent it from reading either light from the exciting source or the pre-dose fluorescence is evaluated. (B.G.D.)

26212 (ANL-7220, pp 115-19) THERMOLUMINESCENT DOSIMETRY AND ENVIRONMENTAL RADIATION STUDIES. Ashby, William C.; Beggs, James N.; Kastner, Jacob; Oltman, B. G.; Moses, H. (Argonne National Lab., Ill.).

A study was undertaken in order to determine the response characteristics of thermoluminescent microdosimeters at levels of background radiation and to examine changes in radiation dose rates in relation to the onset of a growing season and the growth of vegetation. (B.G.D.)

26213 (CONF-650637) LUMINESCENCE DOSIMETRY. Proceedings of International Conference on Luminescence Dosimetry, Stanford University, Stanford, California, June 21-23, 1965. AEC Symposium Series No. 8. Attix, Frank H. (ed.) (Atomic Energy Commission, Washington, D. C. Office of Naval Research, Washington, D. C. Stanford Univ., Calif.). Apr. 1967. Contract AT(04-3)-115. 532p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Separate abstracts were prepared for 28 of the 45 papers presented. Seventeen papers were previously included in NSA. For abstract numbers of these papers see CONF-650637 in the report number index. (B.G.D.)

For abstracts of individual papers see: 26214-26241.

26214 (CONF-650637-, pp 3-33) SURVEY OF LUMINESCENCE DOSIMETRY. Schulman, James H. (Naval Research Lab., Washington, D. C.).

The effects of high-energy radiation on the optical properties of solids are reviewed, with particular attention given to radiation-induced photoluminescence and thermoluminescence. The design and performance of selected devices embodying these materials are described. (auth)

26215 (CONF-650637-, pp 34-43) EARLY STUDIES OF THERMOLUMINESCENCE RADIATION DOSIMETRY. Daniels, Farrington (Wisconsin Univ., Madison. Dept. of Chemistry).

A review article is presented on the early research in thermoluminescence dosimetry. Topics discussed are dosimeter construction, early measurements, uniformity of lithium fluoride, aluminum oxide dosimeters, and recent reactivation of thermoluminescent dosimetry research. (B.G.D.)

26216 (CONF-650637-, pp 47-56) THERMOLUMINESCENCE VS. ROENTGENS IN LITHIUM FLUORIDE: A PROPOSED MATHEMATICAL MODEL. Cameron, J. R.; Zimmerman, D. W.; Bland, R. W. (Wisconsin Univ., Madison. Dept. of Physics).

The integrated thermoluminescence (TL) as a function of the exposure in roentgens (R) was measured for several sources of LiF. All TL vs. R curves show the following properties: for sufficiently low values of R, TL/R is a constant; at higher values of R, TL/R increases linearly with R with the same shape glow curve; and at large values of R, TL/R approaches a constant even though the shape of the glow curve may be changing. A simple model is proposed that assumes an initial number of unfilled traps N_O, the creation of traps by irradiation with a proportionality constant α, the filling of traps by irradiation with a proportionality constant β, and a maximum number of traps N_F. If N is the number of traps (filled and unfilled) at any R and L is the number of filled traps at any R, then $(dN/dR) = \alpha(N_F - N)$ and $dL/dR = \beta(N - L)$ It was possible to fit this equation to the experimental data for the several sources of LiF and thus to evaluate the four parameters N_O, N_F, α, and β for each. These values for TLD-100 are presented. (auth)

26217 (CONF-650637-, pp 57-73) A SIMPLE MODEL FOR THERMOLUMINESCENCE AND THERMALLY STIMULATED CONDUCTIVITY OF INORGANIC PHOTOCONDUCTING PHOSPHORS AND EXPERIMENTS PERTAINING TO INFRARED-STIMULATED LUMINESCENCE. Braeunlich, P.; Schaefer, D.; Scharmann, A. (Giessen Univ. (West Germany). Physikalisches Institut (I)).

Approximate solutions of the well-known balance equations for the kinetic electron processes of thermoluminescence and thermally stimulated conductivity are discussed for the cases where retrapping of electrons and holes is small, where retrapping of electrons and holes is large, where retrapping of electrons is large and that of holes is small, and where retrapping of electrons is small and that of holes is large. The formulas for thermoluminescence by Randall and Wilkins and by Garlick and Gibson are derived as special cases by certain simplifications. Experiments concerning infrared-stimulated luminescence and its application to dosimetry are described. (auth)

26218 (CONF-650637-, pp 74-85) THERMOLUMINESCENCE AND COLOR CENTERS IN LITHIUM FLUORIDE. Claffy, Esther W. (Naval Research Lab., Washington, D. C.).

Magnesium impurity in irradiated LiF produces, at room temperature, color centers with absorption bands at 3100, 3400, and 3800 Å. The 210°C thermoluminescence glow peak in irradiated LiF is related to the presence of magnesium and to the color centers producing the 3400 Å absorption band. The 285°C glow peak, also related to the presence of magnesium, is correlated with the 3100 Å absorption. The relative proportions of the 3100 and 3800 Å absorption bands vary with the thermal history of the crystal from predominantly 3100 Å (aggregated magnesium) to predominantly 3800 Å (dispersed magnesium). The 3400 Å band is usually not directly observable because of band overlap. The bands at 3100, 3400, and 3800 Å bleach upon irradiation into the F band with 2537 Å ultraviolet light and are attributed to hole type defect centers. (auth)

26219 (CONF-650637-, pp 113-17) USE OF LITHIUM BORATE FOR THERMOLUMINESCENCE DOSIMETRY. Schulman, J. H.; Kirk, R. D.; West, E. J. (Naval Research Lab., Washington, D. C.).

Manganese-activated lithium borate, $Li_2B_4O_7$ (0.1 wt. % Mn), may be of value for thermoluminescence dosimetry. A low-temperature glow peak at 55°C decays rapidly on storage, but a stable glow peak at 200°C is useful for dosimetry. Thermoluminescence output (measured by the height of the 200°C peak) is linear with dose to about 150 R, above which it is supralinear. Saturation begins at about 3×10^5 R. The thermoluminescence output per roentgen for lithium borate is about one-tenth that for LiF (TLD-100); thus the minimum detectable γ-ray exposure is about ten times higher than that obtainable with LiF. The calculated energy dependence of the output per roentgen is low, being comparable to and somewhat smaller than the energy dependence of LiF. (auth)

26220 (CONF-650637-, pp 118-31) TERBIUM-ACTIVATED THERMOLUMINESCENT GLASS FOR DOSIMETRY. Ginther, R. J. (Naval Research Lab., Washington, D. C.).

A newly developed terbium-activated lithium aluminosilicate glass is shown to have promise as a thermoluminescent dosimeter. Its sensitivity, energy dependence, spectral distribution of emission, glow-curve characteristic, and storage stability are all favorable for dosimetric purposes. One disadvantage is the supralinear response of the material for γ-ray exposures greater than about 10 R. The advantage of the use of clear glass plates rather than powders is illustrated. Optical studies of the material have shown that the energy traps in the glass are closely associated with the terbium ions. (auth)

26221 (CONF-650637-, pp 132-7) ORGANIC PHOSPHORESCENT MATERIALS. Oster, Gerald; Gabor, Gavriella (Polytechnic Inst. of Brooklyn, N. Y.).

Irradiation by x rays or by ultraviolet light produces an enhanced phosphorescence in plastics containing dibenzanthracene. Samples that have been irradiated exhibit a thermoluminescence when heated above room temperature. The phosphorescence enhancement is accompanied by an increase of the absorption at 450 mμ and by a free-radical electron-spin-resonance signal. When the irradiated material is allowed to stand for long periods of time at room temperature, all these characteristics decay. (auth)

26222 (CONF-650637-, pp 138-57) THERMOLUMINESCENT PROPERTIES OF NATURAL CALCIUM FLUORIDE. Schayes, R.; Brooke, C.; Kozlowitz, I.; Lheureux, M. (Manufacture Belge de Lampes et de Materiel Electronique, Brussels).

A review of important thermoluminescent (TL) properties of natural CaF_2 is made. Most samples show the same fundamental TL peaks but with variable relative and absolute amplitudes. The most often encountered peaks are peaks I and I' below 100°C, peak II at 150°C, peaks III and III' at 275 and 300°C, peak IV at 350°C, and peaks V and VI above 500°C. The absolute efficiency expressed as the energy spent by ionizing particles to create one photoelectron (for perfect optical coupling) is determined for the various phosphors (LiF, CaF_2 : Mn, and natural CaF_2). Measurements were made on variable-thickness phosphors, and the influence of grain size was estimated. The most efficient phosphors were found to be our specially selected and processed natural CaF_2. The effects of high-temperature annealing and very high γ dose are clarified. High-temperature exposure induces a permanent decrease of sensitivity above 600°C without changing appreciably the scintillation properties. Increase of sensitivity under high γ dose exists also, but it is complicated by the dependence on both prior and subsequent (to γ irradiation) heat treatments. Some photoeffects on sensitivity are also noticed. Linearity as a function of the γ-ray exposure extends to the kiloroentgen range, where saturation occurs variably for the different peaks. Superlinearity is also sometimes observed. The light-induced or -modified thermoluminescence is examined in some detail. The three main components of these light effects are separated as a purely light-excited TL, a light-deexcitation effect on filled traps, and the transfer phenomena induced by light irradiation on previously γ-irradiated and erased samples or dosimeters. This last process leads to the possibility of a memory effect. It is shown to be connected with a light-emptying process acting on very-high-temperature traps (peaks V and VI) and a transferring of charge carriers to lower temperature traps, which can be erased by the usual TL measurement (peak III' mainly). (auth)

26223 (CONF-650637–, pp 195-203) USE OF MANGANESE- AND SAMARIUM-ACTIVATED CALCIUM SULFATE IN THERMOLUMINESCENCE DOSIMETRY. Bjarngard, Bengt (Aktiebolaget Atomenergi, Stockholm (Sweden)).

The possibility of employing $CaSO_4$: Mn to measure small γ-ray exposures, taking advantage of the high light yield and the relative absence of serious background problems, was investigated. With the system described, exposures down to 50 μR of 1-MeV γ radiation can be measured. This $CaSO_4$: Mn dosimetry technique has been used for mapping the dose distributions that result when activity is released in air or water. Experience shows that this method is simple, reliable, and useful for such studies. In contrast with the $CaSO_4$: Mn, the most important quality of $CaSO_4$: Sm is the high temperature of the main glow peak. The resulting high stability of the light sum may be utilized for γ-ray dose measurements at elevated temperatures, for which the number of reliable dosimeter types is small. Results from an investigation of the properties of $CaSO_4$: Sm thermoluminescence deviate from those reported previously in some important respects. For instance, the main glow peak lies at a higher temperature, at about 400°C. The light yield is of the same order of magnitude as that of $CaSO_4$: Mn. The signal increases in a superlinear way with the γ-ray exposure or dose. The parameters of this response function have been determined, and the superlinearity is interpreted as caused by the generation of new traps during the irradiation. The fading of the light sum in $CaSO_4$: Sm was investigated under various circumstances. It is concluded that the signal in the 400°C glow peak is stable up to 200°C. If corrections are made for the influence of the temperature on the sensitivity during the irradiation, it is possible to use $CaSO_4$: Sm at 300°C with exposure times that do not exceed some hours. The system presently used does not permit measurements of exposures less than 1 R. Particularly, the emission of incandescent light is a serious background component because of the high temperature needed for the readout procedure. (B.G.D.)

26224 (CONF-650637–, pp 217-26) PERSONNEL DOSIMETRY WITH SINGLE CRYSTALS OF LITHIUM FLUORIDE. Suntharalingam, N.; Zimmerman, D. W.; Kenney, G. N. (Wisconsin Univ., Madison).

An instrument was constructed to measure the thermoluminescence from single crystals of LiF exposed to radiation levels of 10 mR to 1000 R. The reader is basically similar to those described earlier but uses a cooled PM tube and is modified to use about 20-mg single crystals with nitrogen gas flow immediately before reading. It provides both a glow curve and a value of integrated light output for each crystal. A ^{90}Sr–^{90}Y radiation source is built into the reader to permit the calibration of each crystal immediately after reading. Lithium fluoride single crystals in Lucite capsules were attached to film-badge holders and given known test exposures from x- and γ-ray sources. The LiF and film-badge results are compared to the test exposures. The energy response of LiF in these capsules is also discussed. (auth)

26225 (CONF-650637–, pp 227-35) SPURIOUS THERMOLUMINESCENCE AND TRIBOTHERMOLUMINESCENCE IN LITHIUM FLUORIDE DOSIMETRY POWDER. Svarcer, Vesna; Fowler, J. F. (Hammersmith Hospital, London (England). Postgraduate Medical School).

Investigations are described of the nature of the spurious signal appearing at a higher temperature than the dose peak in LiF. Nitrogen removes it. In air or oxygen it can only be produced at full magnitude by movement of the powder. A small proportion of the effect appears, however, if the powder is left undisturbed in the reader tray for many hours. If the powder is stirred with earthed or insulating rods, the effect is greater with the insulating rods. Cementing powder to metal removes the effect. The use of single crystals of LiF also eliminates the effect. These results suggest that the spurious signal is due to surface-trapping states. Adsorbed gases and movement of the powder both would be expected to affect the surface states of the crystals. (auth)

26226 (CONF-650637–, pp 236-43) QUENCHING OF SPURIOUS THERMOLUMINESCENCE BY NITROGEN. Aitken, M. J.; Reid, J.; Tite, M. S.; Fleming, S. J. (Oxford Univ. (England)).

The natural thermoluminescence from ancient ceramics is drastically reduced if the glow curve is taken in an atmosphere of nitrogen instead of air. Whereas the true radioluminescence is unaltered, the glow resulting from other sources (e.g., grinding and chemical change) is largely eliminated. Oxygen-free (less than 10 ppM) nitrogen is necessary to achieve this in some cases. Similar effects are observed with limestone and LiF. For a sample of limestone, the spurious glow in air can be resolved into two peaks, at 420 and 530°C. The different responses to mechanical disturbance and to thermal treatment suggest that the lower peak is triboluminescence but that the higher one is associated with chemical change. Mineralogical separation studies show the lower peak to be carried by quartz impurities and the higher one by microcrystalline calcite. Larger grains of calcite carry piezoluminescence, which is partially quenched in nitrogen. Spurious glow can also be reduced by using carbon dioxide or by painting the glow plate with a reducing agent. Combining the painting with the carbon dioxide (or with nitrogen) reduces the spurious glow from the lithium fluoride by a factor of more than 1000. It is suggested that the removal of spurious glow arises from the absence of oxygen rather than from any specific quenching action. (auth)

26227 (CONF-650637–, pp 244-56) SPURIOUS THERMOLUMINESCENCE OF CaF_2:Mn AND LiF(TLD-100). Nash, A. E.; Attix, F. H.; Schulman, J. H. (Naval Research Laboratory, Washington, D. C.).

Thermoluminescent materials can generally be excited to thermoluminesce not only by ionizing radiations but by certain other stimuli as well. One of these is friction, giving rise to tribothermoluminescent (TTL) light emission. The TTL glow-peak temperature, intensity, and spectral distribution are all influenced by the ambient gas present during the heating and the light emission. The γ-ray-induced thermoluminescence is not influenced in these ways. The surface and volume effects thus seem to be independent of one another. (auth)

26228 (CONF-650637–, pp 259-64) FIELD-EFFECT ENHANCEMENT OF THERMOLUMINESCENCE. Miyashita, K.; Henisch, H. K. (Pennsylvania State Univ., University Park. Materials Research Lab.).

Experiments are described in which average fields of the order of 10^5 V/cm applied to powder phosphors produce an enhancement of thermoluminescence by factors of 100 and more. The enhancement arises in all likelihood from the acceleration of thermally released electrons and subsequent impact ionization. The constancy of the enhancement factors enables the effect to be used for dosimetric purposes. (auth)

26229 (CONF-650637–, pp 308-16) LITHIUM FLUORIDE–TEFLON THERMOLUMINESCENCE DOSIMETERS. Bjarngard, Bengt E.; McCall, Richard C.; Berstein, Irving A. (Controls for Radiation, Inc., Cambridge, Mass.).

When thermoluminescent LiF powder is incorporated into a Teflon matrix, dosimeters can be fabricated which combine ease of handling and readout with reproducible sensitivity. The properties of such LiF-Teflon dosimeters were investigated. Thin disks, 12.5 mm in diameter and 0.13 to 0.5 mm in thickness, containing 25% LiF, and rods, 1 mm in diameter and 6 mm in length, containing 8% LiF were studied. Fabrication of other shapes or dosimeters, as larger and smaller disks and as longer and shorter lengths of rods, is possible. (B.G.D.)

26230 (CONF-650637–, pp 317-21) POSSIBILITIES IN RADIOPHOTOLUMINESCENCE DOSIMETRY AND A RECENT DEVELOPMENT WITH PARTICULAR ATTENTION TO DOSIMETER AND READER TECHNIQUES. Buttler, W. (Total Kommanditgesellschaft Foerstner und Co., Ladenburg (West Germany)).

An evaluation of the absorbed dose with the use of pulsed-light excitation of a phosphate glass previously exposed to ionizing radiation is described. This technique is based on the electronic time integration of fluorescence induced by a single flash of a normal flashlamp. Furthermore, an airtight and moistureproof dosimeter with an identity tag is shown. A strong permanent magnet with specially shaped pole pieces is used to dismantle and assemble the dosimeter for evaluation. (auth)

26231 (CONF-650637–, pp 331-9) SOME APPLICATIONS OF LOW-DOSE THERMOLUMINESCENCE MEASUREMENTS WITH CALCIUM FLUORIDE. Harvey, J. R. (Atomic Weapons Research Establishment, Aldermaston (England)).

An instrument is described that will read commercially available dosimeters that utilize the thermoluminescence of natural calcium fluoride. The most sensitive range is 50 mR. The dosimeters, which are rate independent and relatively insensitive to fast neutrons, have found application in low-level dosimetric studies. A technique is described whereby the light sensitivity of the dosimeter can be used to gain a measure of the total dose to which it has been subjected during its life. (auth)

26232 (CONF-650637–, pp 340-8) RECENT APPLICATIONS OF THERMOLUMINESCENCE DOSIMETRY. Oberhofer, M. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center); Haering, N.; Luchner, K. (Technische Hochschule, Munich (West Germany)).

For several years at the Laboratorium für Technische Physik of the Technische Hochschule München, $CaF_2:Mn$ powder has been used for dosimetric studies. Dosimeters were developed which were used for measuring doses and dose rates in animals that had ingested radiostrontium. The measuring procedure is described, and results are presented. $CaF_2:Mn$ powder also was applied behind thin foils containing ^{6}Li for measuring energy-independent neutron-dose equivalents at a phantom. Results obtained are discussed together with further results of investigations in fast-neutron dosimetry. That there are applications of thermoluminescence outside the field of biology and medicine is best demonstrated by the determination of the average β energy per fission of ^{235}U with the help of a special $CaF_2:Mn$ dosimeter. At Euratom's research center at Ispra, $CaF_2:Mn$ and LiF powders are to be used in the Dosimetry Branch of the Health Physics Division for routine personnel monitoring. Preparations have been made for measuring finger-tip doses with luminescence powder. Investigations are under way to clarify whether luminescence powders can be applied successfully to contamination control and used for surface-dose-rate measurements. (auth)

26233 (CONF-650637–, pp 402-11) MINIATURE THERMOLUMINESCENT DOSIMETER AND ITS APPLICATION IN RADIOECOLOGY. Lucas, Arthur C. (EG and G, Inc., Goleta, Calif.); French, Norman R. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology).

A glass-capillary dosimeter, having an outside diameter of 0.8 mm and a length of 6.0 mm, was constructed and used in radiation tests with reptiles and rodents serving as subjects. The glass tubes are filled with powdered $CaF_2:Mn$ or LiF (TLD-100 or TLD-700). The dosimeter is externally heated by a coil of Nichrome wire. The emitted light is measured with a photomultiplier used in conjunction with an electrometer. The dosimeter was designed for use in a radioecology study involving irradiation of a 20-acre desert site with ^{137}Cs γ rays. The dosimeters were utilized in the 1- to 1000-R range of exposures and were found to have a precision of ±0.1 R or ±3%, whichever is greater. Measurements of γ-ray exposure vs. depth have been performed with both $CaF_2:Mn$ and LiF to depths in the earth of 30 cm, with the measurement period extending over 1 month. Single dosimeters were attached to individual members of a periodically trapped rodent population, and measurements were made of the actual exposures given the irradiated animals. (auth)

26234 (CONF-650637–, pp 359-62) PLACE OF LUMINESCENCE DOSIMETRY IN THE CONTROL OF OCCUPATIONAL HAZARDS OF IONIZING RADIATION. Langmead, W. A. (United Kingdom Atomic Energy Authority, Harwell (England). Authority Health and Safety Branch). (AHSB(RP)R-61).

The objectives of a personnel monitoring program are reviewed, and the main characteristics of systems based on the film badge and luminescent devices are discussed. The requirements to meet the main objectives are summarized; it is suggested that the following dosimeter components satisfy these requirements: a lithium fluoride dosimeter that may be incorporated into the film holder or worn separately adjacent to the badge, a multifilter film badge that may act as a simple spectrometer as well as a dosimeter, and small lithium fluoride dosimeters for special purposes. (auth)

26235 (CONF-650637–, pp 363-71) DIRECT INTERCOMPARISON OF ABSORBED DOSE BY THERMOLUMINESCENT DOSIMETRY. Pinkerton, A. (Sloan-Kettering Inst. for Cancer Research, New York); Holt, J. G. (Memorial Hospital, New York); Laughlin, J. S. (Sloan-Kettering Inst. for Cancer Research, New York); Almond, P. R. (Anderson (M. D.) Hospital and Tumor Inst., Houston, Tex.).

In connection with the use of high-energy x rays and electrons for radiation therapy and radiobiology, quantitative comparability of absorbed dose between different installations is necessary. Although ionization methods have been successfully used for such intercomparisons, the use of LiF appears to have certain advantages. The property of nearly permanent radiation memory makes the use of suitably designed LiF dosimeters feasible for mailing and subsequent reading and/or irradiation. Their compactness permits localization of the dose essentially at a point in a medium. The solid nature of this detector makes it preferable to gaseous detectors, in which the polarization effect is absent, thus giving rise to an undesirable energy dependence in the relation of detector response to tissue dose for high-energy electrons. Dosimeters of ^{7}Li-enriched phosphor have been prepared from separate supplies at both the Memorial Hospital and Sloan–Kettering Cancer Center (Memorial–Sloan–Kettering) and the M. D. Anderson Hospital and Tumor Institute (M. D. Anderson) then interchanged for irradiation, and finally returned to the parent laboratories for dose determination. Irradiations were carried out at doses between 50 and 200 rads with 10- and 15-MeV betatron electrons and ^{60}Co γ rays under similar conditions in either water or polystyrene phantoms. The results of a number of such exchanges, expressed as ratios of thermoluminescent response (i.e., M. D. Anderson/Memorial–Sloan–Kettering) are presented. Measurements also have been made on control samples that had been irradiated prior to the transfer shipments. Long-term reproducibility of measurements is between 1 and 2%. Within this uncertainty, good agreement in the determination of absorbed dose at the two institutions is indicated. (auth)

26236 (CONF-650637–, pp 372-9) EXIT DOSES FOR LUNG AND PHARYNX TREATMENT FIELDS MEASURED BY LITHIUM FLUORIDE THERMOLUMINESCENCE. Svarcer, Vesna; Fowler, J. F.; Deeley, T. J.; Shuttleworth, E. (Hammersmith Hospital, London (England). Postgraduate Medical School).

Lithium fluoride thermoluminescence dosimetry powder was used in capsules to measure the exit doses in patients having treatment to the thorax with 8-MV x rays. Exit doses for fields passing through lungs were up to 60% higher than doses calculated on the assumption of homogenous-density tissue. The dose received at the tumor would thus be increased by approximately half this percentage. Such increases could be satisfactorily explained because the x rays passed through air-containing lung tissue. Where growth, fluid, or fibrosis was present in the lung, the discrepancy was smaller. In cases where the exit dose was lower than expected, the central rays had passed through the spine. In most of the cases, it was possible to explain the observed exit dose after the measurement was made. However, the variation from patient to patient was extremely large, and this could not have been assessed from radiographs or clinical examination. It is therefore not possible to apply general correction factors, and either the exit dose must be measured on each patient, or special techniques of tomography must be employed, if accurately known doses are required. The results of placing an array of LiF capsules on the exit side of air-containing pharynx fields are also presented. (auth)

26237 (CONF-650637–, pp 393-401) IN VIVO THERMOLUMINESCENCE DOSIMETRY OF GAMMA RAYS FROM INGESTED ^{137}Cs IN SHEEP. Watson, C. R.; McClellan, R. O. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Dosimetry of internally deposited γ-ray emitters is complicated by nonuniform distribution of the radionuclide and transient irradiation from nonabsorbed radionuclide in the gastrointestinal tract. LiF thermoluminescence dosimetry (TLD) was used to measure γ-ray doses in vivo in male sheep ingesting ^{137}Cs. Two commercial TLD systems were found satisfactory for measurements of 500 to 800 mR after a nitrogen purge of the readout chamber was added. Specially fabricated Teflon capsules (4 mm wall thickness) shielded the LiF from the β radiation of ^{137}Cs without appreciably attenuating the γ radiation. Dosimeters were surgically implanted and exposed in vivo for 15 days to measure γ-ray dose rates of 20 to 60 mrad/day (total dose, less than 1 rad) in sheep with body burdens of approximately 300 μCi of ^{137}Cs. Dosimeters were implanted in another group of sheep prior to the feeding of 50 μCi of ^{137}Cs per day. These animals were killed at intervals to study the accumulation of γ-ray dose at various organs during a month of ^{137}Cs feeding. Tissue acceptance of the dosimeters was excellent, and dose distribution patterns were similar to those reported earlier. These measurements support the National Committee on Radiation Protection recommendations that assume that designation of the whole body as the critical organ will adequately consider the dose to the gonads in the case of a relatively uniformly distributed γ-ray-emitting radionuclide. (auth)

26238 (CONF-650637–, pp 412-17) APPLICATION OF LITHIUM FLUORIDE (TLD-100) TO TISSUE-DOSE MEASUREMENTS IN HIGH-ENERGY CHARGED-PARTICLE BEAMS. Sondhaus, C. A. (California Univ., Los Angeles. Dept. of Radiological Sciences); Ashikawa, J. K. (University of Southern California, Los Angeles. Dept. of Radiology); Kleppe, L. K.; Miller, F. W.; Patterson, H. W.; Tan, A. S.; Wallace, R. W. (California Univ., Berkeley. Lawrence Radiation Lab.).

A LiF thermoluminescent dosimetry system was built which is capable of accurately measuring γ-ray exposures from 10 mR to more than 30,000 R. Response curves were obtained for γ radiation from ^{60}Co and radium x rays of 100 and 250 kVp, high-energy protons and α particles, and both 5-MeV and thermal neutrons. The problems of reducing variations in the PM-tube dark-current magnitude and increasing the overall stability of the system were solved by use of an infrared filter, by standardization of the operating procedure, and by cooling of the face of the PM tube with room-temperature dry-nitrogen gas. This LiF dosimetry system is currently being used in a variety of biomedical applications, among which are cancer research and space medicine. Other applications include determining the field pattern of x-ray machines and, in the future, personnel monitoring. The system has also been used to study shock- and strain-induced thermoluminescence in limestone. (auth)

26239 (CONF-650637-, pp 467-81) SOME RECENT STUDIES IN NEUTRON GLASS DOSIMETRY. Becker, K. H. (Naval Radiological Defense Lab., San Francisco, Calif.); Tuyn, J. W. N. (Reactor Instituut Delft (Netherlands)).

Recent studies concerning the thermal- and fast-neutron sensitivity of commercial and experimental radiophotoluminescent silver-activated dosimeter glasses are summarized. The thermal-neutron sensitivities of several experimental glasses were calculated and found to be in agreement with ±10% of the experimental values. The effects of glass thickness and ^{10}B and/or ^{6}Li enrichment also were calculated. The different possibilities of increasing the fast-neutron sensitivity of glasses are briefly discussed, and some experimental results are presented (fission and americium/beryllium neutron sensitivity of bare glasses and glasses between moderator layers of different thickness and response of pairs of tin- or cadmium-shielded glasses to different neutron energies). These methods may be of some practical interest for the detection of intermediate- and fast-neutron exposures in personnel dosimetry. For fast-neutron dosimetry, however, the technique of fission-fragment registration in glasses seems to be much more accurate and sensitive. Some results on the visualization of the fission fragments by etching of the glass surface with different solutions and the sensitivity of different glass-fission-coil combinations (natural uranium and thorium, depleted and enriched uranium, and ^{237}Np) to different neutron sources (thermal to 14 MeV) are described. Several aspects of application of these methods in routine dosimetry are discussed: a method for automated counting of the etch pits and a brief description of a proposed multiglass personnel dosimeter for x and γ rays, thermal and fast neutrons, and β rays. (auth)

26240 (CONF-650637-, pp 482-9) LITHIUM FLUORIDE THERMOLUMINESCENT DOSIMETRY FOR BETA RAYS. Kastner, Jacob; Hukkoo, Ramesh; Oltman, B. G. (Argonne National Lab., Ill.).

The possibility of using LiF thermoluminescence for in vivo or in vitro direct-dose measurements in tiny body cavities (e.g., bone marrow) suggested investigation of the response of LiF to β radiation. Several β-ray sources were made in the form of gelatin or polyester-resin molds. The emitters consisted of ^{3}H, ^{63}Ni, ^{36}S, ^{45}Ca, ^{204}Tl, and ^{90}Sr(^{90}Y). The dose rate was computed from the known concentration in each case. Water around the crystal during and after irradiation did not affect the energy storage. As expected, the light output per unit LiF weight and per unit dose was essentially the same for ^{204}Tl and ^{90}Sr as for ^{60}Co, but it dropped markedly for the lower energy β-ray emitters. However, even for tritium, this form of dosimetry is quite feasible provided careful precalibration is carried out with a LiF sample of the specific batch to be employed. Applications to the dosimetry of β-ray applicators are described. (auth)

26241 (CONF-650637-, pp 490-501) THERMOLUMINESCENT RESPONSE TO HEAVILY IONIZING RADIATIONS. Aitken, M. J.; Tite, M. S.; Fleming, S. J. (Oxford Univ. (England)).

Glow-curve measurements were made on various substances (ancient ceramics, limestone, aluminium oxide, bentonite, LiF, and CaF_2) after irradiation with α and β particles, 10-MeV protons, 30-MeV ^{3}He ions, and 50-keV x rays. For ceramics and limestone the results from long irradiations, with successively increasing doses, indicate that significant trap creation may occur with x rays but that the interaction of α particles with the lattice manifests itself predominantly as damage to the thermoluminescent response rather than as an enhancement of it. For low dose levels such effects are small compared to the thermoluminescence arising from the trapping of electrons in existing defects. Indirect evidence about the relative effects of different types of radiation can be obtained from age-determination measurements on archaeological pottery fragments of known date of firing (i.e., thermal drainage) by ancient man. Such measurements are consistent with a thermoluminescent response for α particles that is lower than for β particles by a factor of about 10. This has been confirmed by direct measurements in a number of cases. For LiF the lower sensitivity to α particles is interpreted in terms of localized regions of saturation along the particle tracks. (auth)

26242 (UCRL-17465) IONIZATION FLUCTUATIONS IN CELLS AND THIN DOSIMETERS. Maccabee, H. D.; Raju, M. R. (California Univ., Berkeley. Lawrence Radiation Lab.). Mar. 15, 1967. Contract W-7405-eng-48. 13p. (CONF-670305-2). Dep. CFSTI.

From Symposium on Biological Interpretation of Dose from Accelerator Producted Radiation, Berkeley, Calif.

Since fast charged particles lose energy in matter by a collision process which is discrete and random, statistical fluctuations are expected in the energy loss of such particles when traversing thin absorbers. The theory of ionization fluctuations has been developed by Bohr, Landau, Symon, Vavilov and others, and has been verified by several experimenters, including Maccabee and Raju. Cells and thin dosimeters acts as thin absorbers for many types of particulate radiation, and thus significant fluctuations in energy deposition are to be expected. The application of the theory to these cases and the effect of energy-loss straggling on the Bragg peak of charged particle beams are discussed. (auth)

26243 (UCRL-50007-66-2, pp 21-3) POCKET DOSIMETER RESPONSE IN PULSED RADIATION FIELDS. Kase, Kenneth R. (California Univ., Livermore. Lawrence Radiation Lab.).

A study was performed to determine the dose rate response of pocket ionization chamber dosimeters. (auth)

26244 (UCRL-50007-66-2, pp 23-6) ENERGY DEPENDENCE OF COBALT GLASS. Myers, D. S.; Kathren, R. L. (California Univ., Livermore. Lawrence Radiation Lab.).

The experimental and theoretical response of cobalt glass to low-energy electromagnetic radiation is presented, and a recommendation is made for correcting some low-energy peaks. (auth)

26245 DOSIMETRY OF SMALL BETA RADIATION DOSES BY NUCLEAR EMULSIONS. Tomaskova, Lenka (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Rez). Cesk. Cas. Fys., 17: 256-61(1967). (In Czech).

Nuclear emulsions have been used very frequently for the dosimetry of very small alpha radiation intensities but not for beta radiation where the need for them arises much more often. This work was done to ascertain to what extent nuclear emulsion as a detector of individual traces can be used for the dosimetry of small beta radiation doses of an external source. (auth)

26246 A THERMOLUMINESCENT DOSIMETER (TLD) WITH ENERGY DISCRIMINATION. Spurny, Z. (Inst. of Nuclear Research, Prague). Atompraxis, 12: 617-19(Dec. 1966).

A spectrometrically modified thermoluminescent dosimeter (TLD) is described. A thermoluminescent phosphor with a high atomic number Z seems to be suitable for a badge-type spectrometer. Aluminophosphate thermoluminescent glass was chosen as an example. Such a dosimeter would give information not only on doses, but also on radiation energy. These possibilities point to the further development and use of TLD. (auth)

26247 CONSTANT POWER CIRCUIT FOR HEATING THERMOLUMINESCENT DOSIMETERS. Attix, F. H. (Naval Research Lab., Washington, D. C.). Health Phys., 13: 656-7 (June 1967).

Thermoluminescence readers which measure glow-peak height, and those which measure the light sum, are sensitive to heating rate variations. A circuit is described which delivers approximately constant power, and therefore gives a greater degree of heating rate uniformity. (UK)

26248 NEW REM-COUNTER FOR NEUTRONS. Tatsuta, Hatsumi; Ryufuku, Hiroshi; Shirotani, Takashi (Japan Atomic Energy Research Inst., Tokyo). Health Phys., 13: 559-65(June 1967).

A new Rem-counter for neutrons was designed. The counter has two detector systems, one of which is a BF_3 counter embedded along the center axis in a 30-cm diameter and 32-cm height paraffin cylinder, and the other confirming three BF_3 counters embedded coaxially at intervals of 120 degrees around this axis. Using this counter dose equivalent rates are measured within ±30 per cent for neutrons of typical spectra. Rough estimations of neutron spectra are also given by this system. (auth)

26249 IMPROVED THERMOLUMINESCENCE DOSIMETRY SYSTEM. Hartin, W. J. (Brookhaven National Lab., Upton, N. Y.). Health Phys., 13: 567-73(June 1967). (BNL-10490).

By bonding LiF powder to a high temperature plastic with a transparent high temperature binder it has been possible to produce a re-usable-film badge with the advantages of LiF dosimetry. Because both the plastic and the binder are low Z materials, it is possible to preserve the linear energy response which is one of the advantages of LiF. Since the amount of sensitive material on each dosimeter is fixed, the dosimeter may be accurately calibrated. Obviously this approach simplifies LiF dosimetry because it eliminates the handling and measurement of loose powder. Because the material is in the form of a piece of film of the same size as a standard film badge, it has been possible to work out improved methods for heating it. The photomultiplier tube views a constant temperature source, thus essentially eliminating variations in background currents. This allows measurement of much lower doses. Because a constant temperature source is used, the heating cycle can be accurately controlled, thus improving reading accuracy. The dosimeters are being developed in a form which will facilitate automatic reading, identification, and printout of results. (auth)

26250 LiF:Cu,Ag AND A NEW CaF_2:Mn USED AS THERMOLUMINESCENT DOSIMETERS. Niewiadomski, T. J. (Inst. of Nuclear Physics, Krakow). pp 1-5 of Proceedings of the Second Symposium on Health Physics. Vol. I. Budapest, Publishing Group of the Central Research Institute for Physics, 1966.
See CONF-660948-(Vol.1).

An easy and reproducible method of LiF : Cu,Ag preparation using pure grade reagents and a modification of the GINTHER and KIRK method of CaF_2: Mn preparation, requiring a temperature of only 850°C and a few minutes of time, was elaborated. The luminescence yield of LiF : Cu,Ag provides detection of 1 mrad and low errors at small doses. A single glow maximum appears at 130°C and causes at room temperature a 22% fading of the stored energy during 10 days. Energy dependence is only a little worse than for pure LiF and linearity of response extends up to at least 3×10^4 rads. The phosphor can be used several times and heated on air as a loose powder without change in its properties. The properties of CaF_2: Mn are as good as those for this kind of phosphor, except for linearity which extends only to 10^3 rads. It also has better storage properties. (auth)

26251 THERMOLUMINESCENT DOSIMETRICAL SYSTEM. Kovacs, L.; Roka, O.; Predmerszky, T. (Frederic Joliot-Curie National Research Inst. for Radiobiology and Radiohygiene, Budapest). pp 7-9 of Proceedings of the Second Symposium on Health Physics. Vol. I. Budapest, Publishing Group of the Central Research Institute for Physics, 1966.
See CONF-660948-(Vol.1).

A thermoluminescent dosimeter and appropriate readout equipment were developed for personnel dosimetry with regard to gamma radiation. (B.G.D.)

26252 LOW LEVEL DOSIMETRY UTILIZING THE THERMOLUMINESCENCE OF LiF. Lingertat, H.; Herforth, L.; Frank, M. (Technische Univ., Dresden). pp 11-15 of Proceedings of the Second Symposium on Health Physics. Vol. I. Budapest, Publishing Group of the Central Research Institute for Physics, 1966.
See CONF-660948-(Vol.1).

The use of the LiF thermoluminescent dosimeter in routine personnel dosimetry is mainly limited by the background of the dosimeter. The background components are: the light emission of undosed LiF powder and the fluctuations in the dark current of the photomultiplier. The reason for the light emission of undosed phosphor is discussed. An effective method was elaborated for the stabilization and the reduction of the background of the dosimeter. (auth)

26253 HIGH TEMPERATURE GLOW PEAK THERMOLUMINESCENT DOSIMETER WITH MEMORY EFFECT. Roman, J.; Wolska, M.; Wysopolski, J.; Urbanowicz, Z. (Central Lab. on Radiological Protection, Warsaw). pp 17-21 of Proceedings of the Second Symposium on Health Physics. Vol. I. Budapest, Publishing Group of the Central Research Institute for Physics, 1966.
See CONF-660948-(Vol.1).

A lithium fluoride thermoluminescent phosphor with two well separated glow maxima was developed. The thermoluminescent properties of the phosphor and the dosimeter operating characteristics are given. The dosimeter shows memory effect based on a multiple peak technique permitting for rereading procedure of the accumulated dose without loss of information. (auth)

26254 THE NEW PERSONNEL DOSIMETER OF THE GDR: A COMBINATION OF PHOTOGRAPHIC FILM AND GLASS. Rothe, W.; Kraus, W.; Kiesewetter, W.; Grosse, G. pp 57-60 of Proceedings of the Second Symposium on Health Physics. Vol. I. Budapest, Publishing Group of the Central Research Institute for Physics, 1966.
See CONF-660948-(Vol.1).

The new dosimeter is adapted according the tasks of centralized personnel dosimetry in the GDR. In the same plaque it contains two photoemulsions and one rod-shaped glass dosimeter for the range of accidental exposures. By means of six filters (incl. open window) it is possible to measure x- and gamma-radiation, and to differentiate it from β-radiation. The capability of the dosimeter and the methods of analyzing the dosimeter readings are discussed. (auth)

26255 THE POSSIBILITY OF THE NEUTRON PERSONNEL DOSIMETRY WITH SOLID STATE TRACK DETECTORS. Medveczky, L. (Inst. of Nuclear Research, Debrecen, Hungary); Somogy, G. pp 61-4 of Proceedings of the Second Symposium on Health Physics. Vol. I. Budapest, Publishing Group of the Central Research Institute for Physics, 1966.
See CONF-660948-(Vol.1).

The present state of the slow and fast neutron flux measurements by means of solid state track detectors is summarized. The detection of neutrons is based mostly on registration of fission fragments. A new possibility for detecting fast neutrons by means of counting the tracks produced in the material of α-sensitive plastics is presented. The range of the detection of 14-MeV neutrons is about $10^8 - 10^{12}$ neutron/cm². The particles producing the tracks were identified. (auth)

26256 GEOMETRY EFFECTS AT THE CALIBRATION OF β DOSIMETERS. Herrmann, D. (Inst. for Applied Radioactivity, Leipzig). pp 65-8 of Proceedings of the Second Symposium on Health Physics. Vol. I. Budapest, Publishing Group of the Central Research Institute for Physics, 1966.
See CONF-660948-(Vol.1).

Dosimeter films were calibrated for various β-ray energies and various geometries. The sensitivity of β dosimeters with thicknesses of a few mg/cm² is well defined by the dose rate decrease within the detector and therefore dependent on the calibration geometry, even for the same β-energy distribution. (auth)

26257 DOSIMETRY OF MIXED RADIOACTIVE TELLURIUM ISOTOPES. Erdelyvari, I.; Feher, I. (Central Research Inst. for Physics, Budapest). pp 163-9 of Proceedings of the Second Symposium on Health Physics. Vol. I. Budapest, Publishing Group of the Central Research Institute for Physics, 1966.
See CONF-660948-(Vol.1).

A method for dose calibration was developed in order to determine the dose rates for mixed isotopes by whole body counter. Dose rate measurements were performed on the mixture of radioactive tellurium isotopes and it was found that the value obtained by direct dosimetry differred from that calculated from nuclear data in which the error is large. (auth)

26258 DOSIMETRIC EXPERIENCES WITH ROENTGENOMETER TYPE NS-200/B. Dosay, K.; Bojtor, I.; Koczkas, J.; Urban, J. (Frederic Joliot-Curie National Research Inst. for Radiobiology and Radiohygiene, Budapest). pp 211-15 of Proceedings of the Second Symposium on Health Physics. Vol. I. Budapest, Publishing Group of the Central Research Institute for Physics, 1966.
See CONF-660948-(Vol.1).

The Rontgenometer is a universal dosimeter measuring both x and gamma radiation by the scintillation technique (tissue-equivalent plastic scintillator). To test the applicability of the device in medical practice, its accuracy in measuring dose-intensity and integral dose, the Rontgenometer was studied in detail under voltage and filter conditions common in current practice. The angular and energy dependence of the Röntgenometer were also tested. The results obtained suggested the necessity of further developments. (auth)

26259 ETHANOL–CHLOROBENZENE AERATED SYSTEM AS A NEW HIGH-LEVEL DOSIMETER FOR ROUTINE MEASUREMENTS. Dvornik, I.; Zec, U.; Ranogajec, F. (Inst. Ruder Boskovic, Zagreb). pp 81-90 of STI-PUB-127.

The radiolytic hydrogen chloride yield for ^{60}Co gamma radiation measured as a function of dose (0.05 to 100 Mrad), dose-rate (0.5 to 2500 rad sec^{-1}) and chlorobenzene (CB) concentration was found to be 5 ± 0.1 for CB concentrations between 20 and 40% in a broad range of experimental conditions. The yield is only slightly sensitive to normal impurities. Analytical and lower-grade components gave yields reproducible within a few per cent of this value if 4% water and about 2×10^{-3} $\underline{M}$ benzene and acetaldehyde or acetone were initially present. Higher dosimetric accuracy was obtained if the exact $G(Cl^-)$ was determined for given materials by calibration with the Fricke dosimeter. With 4% CB and 4% water all grades of ethanol gave $G(Cl^-) = 3.65 \pm 0.05$, irrespective of additives. The effect of variation of the water content within ±1% was negligible. The hydrogen chloride concentration in the whole dose range was determined by mercurimetric or alkalimetric titration directly in the irradiated sample with an accuracy of one per cent or better. Incomplete experiments with fast electrons proved that similar systems are of possible interest for calibration and control of industrial irradiations with intense electron beams. The simplicity of preparation and analysis together with the broad range (covered by only one analytical method) and high overall accuracy give to the new dosimeter all the qualities of the almost unique tool for dosimetric calibration of sources and routine control of industrial radiation processing. (auth)

26260 FLUOROGLASS DOSIMETERS. (to Tokyo Shibaura Electric Co. Ltd.). British Patent 1,067,515. May 3, 1967. Priority date July 8, 1963, Japan.

A silver-activated phosphate glass dosimeter is described. The dosimeter has an improved optical system whereby ultraviolet radiation is effectively projected on the fluoroglass for improved measurement of an exposure dose at a high degree of accuracy. (B.G.D.)

26261 IMPROVEMENTS IN OR RELATING TO OPTICAL DENSITOMETERS. Muzlish, Philip (to United Kingdom Atomic Energy Authority). British Patent 1,061,914. Mar. 15, 1967. Filed May 22, 1964.

A densitometer is described for measuring the optical density of a radiation film badge. (B.G.D.)

26262 RADIANT ENERGY SENSITIVE ELEMENT. (to Matsushita Electric Industrial Co. Ltd.). British Patent 1,069,205. May 17, 1967. Priority date Apr. 17, 1963, Japan.

The radiant energy-sensitive element described consists of comingled particles of luminescent and photo-conductive materials, the luminescent material being responsive to an input radiant energy of x rays or γ rays, converting the input energy into another radiant energy and emitting the converted energy. (B.G.D.)

Radiometric Instruments

Refer to abstract 25979.

Miscellaneous Instruments and Components

Refer also to abstracts 26179, 27054, 27068, 27131, and 27544.

26263 (ANL-7220, pp 39-41) PROGRESS IN LOW-RADIOACTIVITY PHOTOMULTIPLIER TUBES. May, H. A.; Steingraber, O. J.; Hess, P. E. (Argonne National Lab., Ill.).

The development of all-metal and all-ceramic photomultiplier tubes using polycrystalline fused alumina or quartz for the transparent window, in order to reduce the amount of background radiation, is discussed. (B.G.D.)

26264 (ANL-7220, pp 60-3) ATMOSPHERIC RADON MONITOR. Taylor, J. A.; Lucas, H. F. Jr. (Argonne National Lab., Ill.).

Two forms of the double filter principle for monitoring atmospheric radon are described. The first is similar to that of Jacobi in that the second filter was replaced by a negatively-charged scintillator. The second utilizes the double filter-paper principle, but deviates in choice of filter papers, physical dimensions, and type of transition section. (B.G.D.)

26265 (AWRE-O-42/67) A 12 CHANNEL, DOPPLER PROFILE SPECTROPHOTOMETER FOR PLASMA SCATTERED LASER LIGHT. Beach, A. D. (Atomic Weapons Research Establishment, Aldermaston (England)). Apr. 1967. 37p. Dep. CFSTI. HMSO 9s. 0d.

A laser/spectrometer combination was developed for the determination of spatially and temporally resolved plasma electron temperatures in the range 200 eV to 4 keV (2 to 40 × 10^{6}°K). The spectrophotometer described here is an f/2, diffraction grating instrument with a 12 channel, sequenced pulse output, suited for use as a laboratory tool, and compatible with the space requirements of parallel instrumentation observing the same plasma. (auth)

26266 (BNWL-406) MICROWAVE DETECTION OF MOISTURE IN REACTOR COOLANT GAS. Brown, D. P.; Billeter, T. R. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). May 1967. Contract AT(45-1)-1830. 20p. Dep. CFSTI.

The use of microwaves to detect and measure the moisture content of gases used for cooling reactors was investigated. The detection sensitivity is limited by the stability of the microwave generator, its associated references, and the ability to measure frequency changes. At room temperature, the change in the dielectric constant of the gas mixture is measured by the change in the resonant frequency of a microwave cavity through which the gas flows. Detection sensitivity is 85 ppm change at concentrations of 400 ppm water vapor in helium. Because the dielectric constant is a function of temperature, an increase in temperature will decrease the dielectric constant and will reduce detection sensitivity. At 436°C, the detection sensitivity was 875 ppm of water vapor in helium. (auth)

26267 (DUN-SA-32) HIGH SPEED SCANNING SYSTEM TEMPERATURE MONITOR. Sherrard, R. (Douglas United Nuclear, Inc., Richland, Wash.). [1967]. 20p. (CONF-670319-1). Dep. CFSTI.

From Conference on Instrument Society of America, Richland, Wash.

A scanner system for monitoring reactor temperatures is described. The system is a dual one containing both high speed and low speed scanning. The high speed portion of the system examines each of 3200 temperatures in 200 microseconds and covers the entire process in 0.744 seconds. The low speed system is used for automatic logging of temperatures in reactor format on a preprinted form at a speed of 4.5 temperatures per second and for traverse and trend recording of all temperatures. The program history major benefits from on-reactor use, physical layout of scanner system, a description of scanner system functions, and the reliability performance of the scanner system are discussed. (B.G.D.)

26268 (INP-527/PS) MECHANICAL SELECTOR OF NEUTRON VELOCITIES. Krasnicki, Szczesny; Dec, Jerzy; Rapacki, Henryk (Institute of Nuclear Physics, Krakow (Poland)). Feb. 1967. 18p. Dep.

The construction of a mechanical high transmission selector of neutron velocities is described. The monochromator is designed for cooperation with the Cracow Neutron Crystal Spectrometer as a cleaner of the monoenergetic neutron beam contaminated by higher-order reflections. The results obtained during the testing period of the device are given. (auth)

26269 (INR-769/III/E) PRZETWORNIK ANALOGOWO-CYFROWY DO 256-KANALOWEGO ANALIZATORA AMPLITUDY. (The Analog-to-Digital Converter for 256-Channel Amplitude Analyzer). Bayer, R. (Institute of Nuclear Research, Warsaw (Poland)). Dec. 1966. 18p. (In Polish). Dep.

An analog-to-digital converter for 256-channel amplitude analyzer was built. Its operating principles and characteristics are described. Some results of measurements are given. (auth)

26270 (K-L-6147) TIME-FORCE INTEGRATOR OPERATING AND MAINTENANCE MANUAL. Bartkus, M. J. (Oak Ridge Gaseous Diffusion Plant, Tenn.). May 15, 1967. Contract W-7405-eng-26. 36p. Dep. CFSTI.

An operation and maintenance manual is presented for the Time-Force Integrator ($\omega^2 t$) which is used with liquid centrifuges in biological research to provide a numerical value related to the centrifuge force applied to the centrifuge material. (B.G.D.)

26271 (KFK-276) EIN AUTOMATISCHES MESSWERTERFASSUNGSSYSTEM FUER AKTIVITAETS- UND LEBENSDAUERMESSUNGEN AN RADIOAKTIVEN PRAEPARATEN. (An Automatic Measurement Evaluation System for Activity and Lifetime Measurements on Radioactive Preparations). Gruber, P.; Hartenstein, R. (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (West Germany). Kernforschungszentrum, Karlsruhe (West Germany)). Feb. 1965. 31p. (In German). Dep. mn.

An electronic system built according to ESONE recommendations is described. The method permits automatic data processing from several radiation measurement plates operating independently of each other on a single data output control device which can drive a TALLY perforated tape punch and an IBM pen recorder. (tr-auth)

26272 (KFK-511) DER ELEKTROMAGNETISCHE ISOTOPENSEPARATOR IM ZYKLOTRON-LABORATORIUM DES KERNFORSCHUNGSZENTRUMS KARLSRUHE. (Electromagnetic Isotope Separator in the Cyclotron Laboratory of the Karlsruhe Nuclear Research Center). Fabricius, H.; Freitag, K.; Goering, S.; Hanser, A.; Langmann, H.-J. (Kernforschungszentrum, Karlsruhe (West Germany). Zyklotron-Laboratorium). Dec. 1966. 36p. (In German). Dep.

An electromagnetic isotope separator was constructed for the separation of radioactive isotopes with total activities up to several mCi and the separation of stable isotopes for the preparation of very isotope-pure targets in masses up to several mg. The ion optics of the separator are described in detail; the construction and operation of the magnet, ion source, collector, and vacuum installation are also described; and test measurements made are reported. The uses and further development of the separator are indicated. (J.S.R.)

26273 (NAA-SR-Memo-12249) ANAGRAPH: A CODE FOR GRAPHICAL DISPLAY OF SINGLE AND MULTIPLE SETS OF DIGITAL DATA. Medeiros, Katherine W.; Beller, L. S. (Atomics International, Canoga Park, Calif.). Nov. 22, 1966. Contract AT(11-1)-Gen-8. 35p. DTIE.

This memo describes a computer program written to provide for the graphical display of multiple data points. It was written expressly for use with data from multichannel analyzers, but is not limited to this source. Many options allow for wide flexibility in use. Description of the code, input instructions, sample input data, output and listings are included. (auth)

26274 (NP–16372) BASIC ELECTRONICS TECHNOLOGY AND TESTING PRACTICES. Technical Manual. ([Oklahoma City AMA, Tinker AFB, Okla.]). June 15, 1966. Contracts AF 36(600)-21510; AF 34(601)-25052. 62p.

A technical manual containing general testing information of electronic equipment as well as safety precautions associated with installation and use of electronic equipment is presented. (B.G.D.)

26275 (NYO–3622-8) APPLICATIONS OF ULTRASONIC ENERGY: ULTRASONIC INSTRUMENTATION FOR NUCLEAR APPLICATIONS. Bimonthly Progress Report No. 33, February 1–March 31, 1967. (Aeroprojects, Inc., West Chester, Pa.). Apr. 1967. Contract AT(30-1)-3622. 8p. Dep. CFSTI.

Plans for installing the ultrasonic incipient boiling detector in a dynamic test loop were discussed. Specifications for a suitable dynamic system were evolved, and detailed designs were prepared. Flow measurements in water as a simulant for molten metal, using the ultrasonic flowmeter, showed a linear relation between transient time as measured by the instrument and flow rate, at rates up to 14–18 gallons per minute. Plans were made for experimental effort to improve operation of the flowmeter. (auth)

26276 (SC-DR–67-149) MICROBAROGRAPH SYSTEMS STUDY. Lareau, J. G. (Sandia Corp., Albuquerque, N. Mex.). May 1967. Contract AT(29-1)-789. 32p. Dep. CFSTI.

A microbarograph system was developed which is reliable and compact. An analysis of the system presently in use, the design information and equipment needed for analysis, and the proposal system are presented. (B.G.D.)

26277 (UCRL–17011) ANALYSIS AND DESIGN OF A PULSE-WIDTH-MODULATED CONTROL SYSTEM. Denison, Craig Allen (California Univ., Berkeley. Lawrence Radiation Lab.). Mar. 1967. Contract W-7405-eng-48. 83p. Dep. CFSTI.

Thesis.

The design of a pulse-width-modulated (PWM) regulator-type controller for a servomotor-type of plant is described. The objectives are: to derive the equations which describe the time-optimal strategy for the specific case of the servomotor plant, to discuss PWM control using linear feedback and what are the apparent limitations of the present design techniques, to define a set of linear feedback coefficients in a manner so that the system's trajectory can be very close to the time-optimal trajectory, and to compare the performance of the time-optimal and linear PWM controllers. The approach to the design problem is principally one of utilizing the time-optimal control strategy to suggest a design for a simple (but suboptimal) linear feedback, PWM controlled system. Considerable experimental results from computer simulations are presented. These results indicate how the relative performance of the optimal and linear controllers depends on the sample period size, the target size, and several different initial conditions. (auth)

26278 (UCRL-50007)-66-2, pp 26-8) USE OF THE α/β RATIO TO REDUCE AIR FILTER PAPER DECAY PERIODS. Lindeken, C. L.; Denham, D. H. (California Univ., Livermore. Lawrence Radiation Lab.).

Detection of airborne plutonium on air sample filters is investigated by noting the increase in the thoron daughter α/β activity ratio. (auth)

26279 (UCRL-Trans–1347) MEASURING EQUIPMENT FOR THE EXACT POINT-BY-POINT DETERMINATION OF LARGE-SURFACE MAGNETIC FIELDS. Schadebrodt, G. Translated by A. B. Herrmann (Univ. of California, Lawrence Radiation Lab., Berkeley), from IEEE (Inst. Elec. Electron. Eng.), Trans. Magnet., 2: 547-9(1966). 11p. (CONF-660436–2). Dep. CFSTI. JCL $1.60 fs, $0.80 mf.

From Intermag Conference, Stuttgart, Germany.

The principle underlying the method of automatic measurement of air gap flux densities is discussed. With this, a search coil is used and the voltage by time area is converted into a sequence of pulses in a voltage frequency transformer. An after-connected counter effects indication of the voltage by time area in decimal form. The measuring program can be punched in digital form on a tape. The accuracy obtainable as well as the various sources of errors are dealt with. (auth)

26280 SEMIAUTOMATIC DATA-COLLECTION SYSTEMS FOR MASS SPECTROMETERS. Moreland, P. E. Jr.; Stevens, C. M.; Walling, D. B. (Argonne National Lab., Ill.). Rev. Sci. Instrum., 38: 760–4(June 1967).

Two programmed, digital data-collection systems were developed and used with static-field mass spectrometers to improve the precision of isotopic analyses of solid samples and to reduce the time required for collection and reduction of data. A large high-sensitivity spectrometer using ion pulse counting detection was equipped with a programmer and multiscaler so that up to four masses can be sequentially scanned and the resulting counts stored in different groups of the core memory. The simpler scheme of adding a programmed integrating digital voltmeter to sample the detector output of an analytical spectrometer is used where high sensitivity is not required. Both instruments use voltage switching between masses and magnetic sweeping of the mass peaks. Mass programming is done simply, but precisely and directly, by the use of the operational amplifier techniques in voltage supplies. (auth)

26281 NANOSECOND TIME-OF-FLIGHT STUDIES OF ELECTRONS. Nakai, M. Y.; LaBar, D. A.; Harter, J. A.; Birkhoff, R. D. (Oak Ridge National Lab., Tenn.). Contract W-7405–eng-26. Rev. Sci. Instrum., 38: 820–6(June 1967). (ORNL-P–2630).

Low-energy electron guns were constructed in planar and coaxial geometry. When pulsed with nanosecond pulses from an avalanche transistor pulser, they emit bursts of electrons of a few nanoseconds duration having energies adjustable between 1 and 15 eV. Electrons are focused along a drift tube by a magnetic field of the order of 1 G and are collected and then amplified by a 3-stage transistorized pulse amplifier for display on a sampling oscilloscope. For microsecond drift times an energy resolution of about 0.01 eV is calculated. The depletion of 2.5–eV electrons in the time-of-arrival distribution when the pumping system was cut off from the drift tube was attributed to vibrational excitation of N_2, and a cross section of 1.34×10^{-15} cm^2 was determined. When the drift tube was re-evacuated and a jet of nitrogen gas was directed across the electron beam at right angles to it and close to the gun, the time-of-arrival distribution revealed energy losses of 0.6 or 1.0 eV which were attributed to vibrational excitation of the $v = 0$ to $v = 2$ or $v = 3$ levels in nitrogen. These experiments, plus work done in other laboratories on gating grid arrangements, seem to indicate that a time-of-flight electron monochromator having energy resolution comparable to the best systems in operation at this time may be possible in the future. (auth)

26282 FAST HIGH CURRENT PULSE GENERATOR. Pearce, T. W.; Hochberg, A. K.; Poehler, T. O. (Johns Hopkins Univ., Silver Spring, Md.). Rev. Sci. Instrum., 38: 835-7(June 1967).

A fast high current pulse generator is described which supplies pulses up to 500 V and 1000 A with a pulse duration as low as 0.5 μsec. (B.G.D.)

26283 MAGNETIC AMPLIFIER FOR USE AT 4.2^{0}K. Foiles, C. L. (Michigan State Univ., East Lansing). Rev. Sci. Instrum., 38: 731-3(June 1967).

A magnetic amplifier used at 4.2°K to measure small dc voltages is described. A sensitivity of 5×10^{-3} μV was obtained without any precaution other than second harmonic detection for eliminating ac noise. Suggestions for increased sensitivity and comparisons with other techniques are given. (auth)

26284 FAST LINEAR GATE. Ryu, Norio; Nishi, Masato (Hiroshima Univ.). Jap. J. Appl. Phys., 6: 765-70(June 1967).

A fast linear gate was designed and its performance examined for simulated pulses similar to those from a photomultiplier anode. A pair of fast transistors function as a gate by exchanging their bias voltages with a gating pulse. The amplification of the circuitry is almost linear up to about 11 mA input pulse. This ensures very fast response, good fidelity of pulse shape, low output impedance and a stable gain of around two. A pulse fed through the circuit without gate input is only 1.6% of the input pulse, and the gate pedestal at the output in the absence of input pulse is a transient pulse of less than 10 mV. These characteristics allow the circuit to satisfy the various requirements of nuclear experiments. (auth)

26285 INVESTIGATION OF THE EXTRACTION AND THE SHAPING OF ION BEAMS IN PLASMA ION SOURCES. Raiko, V. I. (Inst. of Atomic Energy, Moscow). Kernenergie, 10: 85-9(Mar. 1967). (In Russian).

Some results of studies on the ion-optical system of an electromagnetic separator plasma ion source are given. Considering the decomposition mechanism of the ion beam space charge shows that the productivity of the source is possible to be essentially increased when the geometry of the ion-optical system and the corresponding optimal regime of operation are chosen in an adequate manner. (auth)

26286 NOISE IN PHOTOMULTIPLIER TUBES. Eberhardt, E. H. (ITT Industrial Labs., Fort Wayne). IEEE (Inst. Elec.

Electron. Eng.), Trans. Nucl. Sci., NS-14: No. 2, 7-14(Apr. 1967).

Direct measurements of the statistical gain fluctuations occurring in the electron multiplication process in a sampling of multiplier phototubes are reported. The results are expressed in terms of the effective reduction of the photocathode quantum efficiency, i.e., the noise factor, as determined by a comparison of the experimentally observed output signal-to-noise ratio with the expected ratio based on independent direct current measurements of photocathode quantum efficiency. The spread in the measured magnitudes of the resultant noise factor, in nominally identical tube types, is sufficient to demonstrate that both photocathode quantum efficiency and electron multiplier noise factor should be specified if optimum detector performance is to be assured. (auth)

26287 GAMMA SPECTRA ANALYSIS USING SPECTRAL SENSITIVITY MATRIX. Hrabovcova, Alojzia (Research Inst. for Industrial Health Protection and Occupational Disease, Bratislava). Jad. Energ., 13: 105-9(Mar. 1967). (In Czech).

The principle of transformation of pulse amplitude spectra into power spectra of γ radiation measured by a scintillation γ spectrometer, which operates by the principle of, so called, matrix spectral sensitivity is described. A review is given of published data on the elements of this matrix and the difficulties connected with such a method of investigation as well as the tendencies of scientific studies in order to eliminate these difficulties. (tr-auth)

26288 RADIOMETRIC METHOD FOR TUNGSTATE DETERMINATION. Hudec, Imrich (Mining Inst., Prague). Jad. Energ., 13: 23-4(Jan. 1967). (In Czech).

A radiometric method based on β scattering and used for determining the content of WO_3 in potassium tungstate and other materials containing tungsten is described. The obtained results were compared to the results obtained by a classical gravimetric method. (R.V.J.)

26289 NANOSECOND GROUP PULSE GENERATOR OF LOW IMPEDANCE. Bachmann, K. (Institut fuer Nachrichtentechnik, Berlin); Goetsch, A.; Schulze, K. Exp. Tech. Phys., 14: 303-11 (1966). (In German).

An independently uncoupled pulse generator for pulse probe measurements, which produces a group of twenty pulses within a time interval of about four μ sec, was described. The tooth-shaped pulses have a rise time of 25 nsec. The pulse width (base point width) is about 150 nsec. At 1,000 V anode voltage a 90-amp pulse peak current and 450-V pulse peak voltage at a load resistance of 5 Ω were obtained. The pulses were produced by short time charge of capacitors. Rare gas thyratrons were introduced as the active switching element. (tr-auth)

26290 USE OF AN IBM-COMPATIBLE INCREMENTAL MAGNETIC TAPE RECORDER AS AN INPUT/OUTPUT DEVICE FOR A MULTICHANNEL ANALYZER. Algranati, M.; Nunamaker, T.; Sachs, M. W. (Weizmann Inst. of Science, Rehovoth, Israel). Nucl. Instrum. Methods, 50: 213-24(1967).

An IBM-compatible incremental magnetic tape recorder has been added to a commercial multichannel pulse height analyzer. The main features of the system are described. (auth)

26291 TUNNEL DIODE ZERO CROSSING VARIABLE DISCRIMINATOR. Bernaola, O. A.; Filevich, A.; Thieberger, P. (Instituto de Fisica J. A. Balseiro, Centro Atomico Bariloche, Argentina). Nucl. Instrum. Methods, 50: 299-301(1967).

A simple discriminator circuit for bipolar pulses is described. The circuit has a variable discrimination level and gives output pulses accurately synchronized with the zero cross-over point of the input pulses. The shift of the output pulses is less than 1 nsec over the whole range (0.45 V to 10 V) of input pulse heights and/or discriminator level settings. Measurements of the linearity and temperature stability of this circuit were performed. (auth)

26292 DESIGN STUDY FOR A LARGE ANGLE ($\theta \rightarrow 180°$) SCATTERING FACILITY FOR CHARGED PARTICLES. Burge, E. J. (King's Coll., London). Nucl. Instrum. Methods, 50: 209-12(1967).

A facility is described which allows the study of charged nuclear particles emitted from targets at angles ranging from 120°–180° relative to the incident beam, and has limited applications for angles near 0°. It requires a small magnet with its field perpendicular to the scattering plane and acting in the region of the target. Detailed design calculations are presented for a 50-MeV incident proton beam with allowance for 50-MeV tritons emitted at 180°. The scattering facility is designed to be used in conjunction with the high resolution double focussing magnet at the Rutherford High Energy Laboratory, Chilton. (auth)

26293 INEXPENSIVE MULTI-CHANNEL TIME ANALYSER. Fullwood, R. R. (Rensselaer Polytechnic Inst., Troy, N. Y.). Nucl. Instrum. Methods, 50: 261-4(1967).

An inexpensive 128 channel pulse height analyzer was equipped with a time digitizer which operates in increments ranging from 0.5 μsec to 256 μsec per channel. This in no way interferes with the original ability of the analyzer to switch selectively in Mössbauer, multiscaling or pulse height modes. The system also features oscilloscope display, printed and punched paper tape output at a total equipment cost of $5500. (auth)

26294 STATISTICS OF A TWO-PARAMETER ANALYZER WITH ASSOCIATIVE MEMORY. Bell, R. E. (McGill Univ., Montreal). Nucl. Instrum. Methods, 50: 258-60(1967).

Pulse-height analyzers with associative memories of M words are discussed, where M is very much smaller than the total number of possible different channels. It is shown that if the first M channels to record one event each are stored, the probability that any given channel is included in the store is simply proportional to its counting rate. The counts per channel in a region of the spectrum are therefore indicated not only by the contents of the recorded channels. In general, if the first M channels to record n events each are stored, the inclusion probability is proportional to the channel counting rate raised to the nth power. (auth)

26295 DEFLECTION OF SLOW NEUTRONS WITH A CURVED TOTAL-REFLECTING COLLIMATOR SYSTEM. Fiala, W.; Rauch, H. (Oesterreichische Hochschule, Vienna). Nucl. Instrum. Methods, 52: 15-24(June 1967). (In German).

The deflection of thermal-, Be- and Bi-filtered neutrons behind a curved totally reflecting collimator system was investigated as a function of curvature and width of the Soller-slits. The measurements were carried out with Ni-, Cu- and glass-collimators. By means of the method described it is possible to deflect especially cold neutrons up to 5–6 times the critical total reflecting angle without any remarkable loss in intensity. Using an appropriate design of the collimator, this system can be used also as a neutron filter and for neutron focusing. (auth)

26296 SYMMETRY DEFECTS IN POLARIZATION MEASUREMENTS. V. DISCUSSION OF THE EFFECTS OF INSTRUMENTAL SYMMETRY DEFECTS IN THE CASE OF POLARIZATION MEASUREMENT METHODS USING A PRECESSION MAGNETIC FIELD. Libert, J. (Institut Interuniversitaire des Sciences Nucleaires, Mons, Belg.). Nucl. Instrum. Methods, 52: 48-66(June 1967). (In French).

The influence of the experimental symmetry defects on the experimental conditions of a polarization determination is described for methods of measurement using a precession magnetic field, in connection with a general formulation of the problem, the correctness of which in this particular case is so proved. By introducing in the general conditions which must be fulfilled by the factors expressing the influence of the symmetry defects in a general way, the particular form assumed by these factors when the symmetry defects are experimental ones, it is possible to state precisely the experimental symmetry defects, the influence of which is avoided completely or not, rigorously or provided that some approximations are valid. It is concluded that all the methods of measurement are nearly equivalent. (auth)

26297 USING A COMPUTER FOR SIMULTANEOUS DATA COLLECTION AND COMPUTATION. Hobbie, R. K.; Goodwin, R. W. (Univ. of Minnesota, Minneapolis). Contract AT(11-1)-1265. Nucl. Instrum. Methods, 52: 119-21(June 1967). (COO-1265-41).

A computer system for on-line data collection is described. Data enters memory via a special interface. The storage locations for data become part of the Resident system, so other calculations may be carried out at the same time. Fortran has been modified so that it can refer to these memory locations. (auth)

26298 DETERMINATION OF STATISTICAL PARAMETERS OF A TRIPLE COINCIDENCE CIRCUIT. Kalisz, J. (Inst. of Nuclear Research, Swierk, Poland). Nucl. Instrum. Methods, 52: 141-7(June 1967).

The basic statistical theory of a triple coincidence circuit is presented with the assumption of Gaussian jitter distributions and the concepts of the "coincidence surface" and the "coincidence curve" are formulated. Two mathematical methods are described for determination of the main statistical parameters of the circuit (resolving time, jitter breadth, efficiency) on the basis of a single empirical coincidence curve. The general approach and some particular cases are presented. The results of numerical calculations and an example illustrating one of the proposed methods are given. (auth)

26299 SIMPLE COINCIDENCE CIRCUIT WITH A SIMULTANEOUS RANDOM MONITOR. Avida, R.; Gorni, S. (Hebrew Univ., Jerusalem). Nucl. Instrum. Methods, 52: 125-9(June 1967).

A coincidence circuit is described, which measures simultaneously the true and random events. This is achieved by branching the incoming pulses of one channel to two different delays and mixing them at the input to the main coincidence. Coincidences with each branch are separately monitored. (auth)

26300 OPERATING POINT OF A FET FOR OPTIMUM NOISE PERFORMANCE. Ferrari, A. M. R. (Tennelec Instrument Co., Inc., Oak Ridge, Tenn.). Nucl. Instrum. Methods, 52: 179(June 1967).

Experimental support for the choice of FET operating conditions in the input stage of Tennelec Model TC 130 preamplifier is presented. Noise measurements show that the optimum operating point for a field effect transistor is in the vicinity of 0 V gate bias. The ratio g_m/C_{in} is maximum at the same bias point, which is consistent with the results of the noise measurements. (auth)

26301 EASILY CONSTRUCTED HIGH PRESSURE LAMP FOR THE PRODUCTION OF INTENSE LIGHT PULSES IN NANOSECOND REGION. Franke, H. G.; Schmeing, H. (Univ., Muenster, Ger.). Nucl. Instrum. Methods, 52: 171-2(June 1967). (In German).

A lamp of the gaseous discharge type is described, which generates subnanosecond light pulses. It is filled with hydrogen to 30 atm pressure. The lamp can easily be built within a few hours. (auth)

26302 SIMPLE, UNIFORMLY VARIABLE SIGNAL-DELAY APPARATUS FOR DELAY TIMES OF 10 ns TO 100 μs. Franke, H. G.; Fritz, R. (Univ., Muenster, Ger.). Nucl. Instrum. Methods, 52: 163-5(June 1967). (In German).

An inexpensive delay circuit working in the range of 10 ns to 100 μs is described. (auth)

26303 OPTICAL METHOD FOR SAWTOOTH WAVE GENERATION. Yang, Yu-tung (National Tsing-Hua Univ., Taiwan. Academia Sinica, Taiwan). Nucl. Instrum. Methods, 52: 155-6 (June 1967).

A sawtooth wave is generated by a moving shadow. The frequency range of the generator is from less than 10^{-4} Hz to about 10 Hz. The power output is obtained by using a linear amplifier. The linearity of the wave is absolute in principle. However, experimentally the linearity was found to be around 0.01%. (auth)

26304 PRESSURE DEPENDENCE OF THE ANODE DROP VOLTAGE IN HIGH PRESSURE ARCS. Schoeck, P.; Maisenhaelder, F. (Institut fuer Plasmadynamik, Stuttgart). Beitr. Plasmaphys., 6: 345-64(1966). (In German).

The dependence of the anode fall voltage of freely burning high pressure arcs was investigated on the basis of a simplified arc model. It was found that the anode fall voltage does not contribute to the observed increase of arc voltage with pressure. The analysis was based on experimental investigations carried out with an argon arc. Due to the self-magnetically produced plasma flow a stagnation point flow pattern developed at the anode. The experiments were conducted at currents of $I = 100$ and 150 A. The pressure was varied between $p = 1$ and 50 atm. The applied method necessitated the determination of the anode energy balance. As a side result of the investigation it was found that radiation contributes at $p = 1$ atm with appr. 20% and at $p = 50$ atm with appr. 50% to the total arc energy balance. (auth)

26305 CALIBRATION OF REFRACTORY METAL THERMOCOUPLES. Zysk, E. D.; Toenshoff, D. A. Engelhard Ind., Tech. Bull., 7: 137-47(Mar. 1967).

The methods of calibration of a thermocouple intended for use at 1500°C and above are discussed. Factors affecting high temperature calibration such as the International Practical Temperature Scale of 1948 (IPTS), standard tables, methods of calibration, equipment, materials and sources of error are discussed. Finally, an example of a calibration method used to develop a standard table for a refractory metal thermocouple tungsten-3% rhenium vs tungsten-25% rhenium is presented. (auth)

26306 CALCULATION OF THE NEUTRON ANGULAR DISTRIBUTION BEHIND A CURVED TOTALLY REFLECTING COLLIMATOR SLIT. Binder, K.; Rauch, H. (Oesterreichische Hochschule, Vienna). Atomkernenergie, 12: 145-58(May-June 1967). (In German).

The angular distribution of thermal and Be-filtered neutrons behind a curved totally reflecting Soller collimator slit was calculated for different curvatures, slit widths, materials and reflection coefficients. By means of the calculated distributions it is possible to determine the most favorable dimensions of the Soller slits for a required neutron deflection. It is shown that even for a great deflection the loss in intensity is small, if the collimator is properly designed. The results are useful for the construction and calculation of a curved totally reflecting Soller system for polarized neutrons also. The calculated results are compared with experimental ones. (auth)

26307 INVESTIGATIONS ON THE MEASUREMENT OF THE RADIOACTIVE IODINE CONTENT OF THE AIR. Ullmann, W. (Inst. of Applied Radioactivity, Leipzig). pp 183-7 of Proceedings of the Second Symposium on Health Physics. Vol. I. Budapest, Publishing Group of the Central Research Institute for Physics, 1966.

See CONF-660948-(Vol.1).

Radioactive iodine may be present in the air in the form of a vapor as well as in the form of an aerosol. A single-stage procedure is described, which allows the detection of the total content of iodine in air by application of commercial aerosol filters treated with silver nitrate. Furthermore, the most important characteristics are specified for filter materials suitable for detecting vapors and aerosols separately. (auth)

26308 MICROSCOPE PHOTOMETER FOR MEASUREMENTS TO MICROAUTORADIOGRAPHS. Kraus, W. (Radiation Protection Center of the GDR, Berlin). pp 217-20 of Proceedings of the Second Symposium on Health Physics. Vol. I. Budapest, Publishing Group of the Central Research Institute for Physics, 1966.

See CONF-660948-(Vol.1).

A microscope photometer is described, mainly constructed from commercial elements, and well adapted for measurements of microautoradiographs. A photomultiplier serves as the light sensitive element. The measuring area is continuously adjustable, its smallest value runs to $2 \times 2\ \mu m^2$. Densities up to $D = 4.5$ are measurable. The problem of illuminating the measuring area is especially discussed and the Schwarzschild–Villiger effect for measurements in the autoradiographic emulsion is determined with a new method. An example for using the instrument is briefly presented. (auth)

26309 HIGH SPEED CONSTANT CURRENT SWITCH FOR USE WITH THE NATIONAL PHYSICAL LABORATORY PLASMA–METAL JUNCTION HARMONIC GENERATOR. Bradsell, R. H. (National Physical Lab., Teddington, Eng.). J. Sci. Instrum., 44: 406-8(May 1967).

This plasma-metal junction harmonic generator is based on the nonlinear properties of the cathode spot of an arc established in a gas at high pressure. In order to inhibit transfer of metal from one electrode to the other the arc must be maintained by a source of constant current, of up to 0.5A, whose polarity is reversed at an audio frequency with a submicrosecond switching time. A solid state device meeting requirements and having a switching time of less than 0.2 μsec is described. (auth)

26310 SOME IMPROVED CIRCUIT TECHNIQUES FOR ELECTRON SPIN RESONANCE SPECTROSCOPY. Wilmshurst, T. H. (Univ. of Southampton, Eng.). J. Sci. Instrum., 44: 403-5(May 1967).

Circuits are described which, when included in an electron spin resonance spectrometer using 100 kHz field modulation, give a sensitivity that is stable to 1% both over short periods and from day to day. Wide use is made of integrated microcircuits and the resulting simplification in design is illustrated. A novel system for stabilizing the 100 kHz field modulator is included. (auth)

26311 SENSITIVE 8 MM ELECTRON SPIN RESONANCE SPECTROMETER USING DOUBLE SIDEBAND DEMODULATION. Patankar, A. V. (Univ. of Newcastle upon Tyne, Eng.). J. Sci. Instrum., 44: 354-6(May 1967).

The technique of double sideband demodulation is discussed in the light of its usefulness in electron spin resonance spectrometry. Its effect on noise figures of the receiver is explained. A sensitive Q-band (8 mm) electron spin resonance spectrometer using this method is described. The experimental sensitivity of the spectrometer was found to be 3×10^9 spins of the unit gauss width at one watt microwave power. The system is stable over a range of microwave powers and frequencies. (auth)

26312 IMPROVED CIRCUIT FOR NUCLEAR MAGNETIC RESONANCE DETECTION. Faulkner, E. A.; Holman, A. (Univ. of Reading, Eng.). J. Sci. Instrum., 44: 391-2(May 1967).

It was found that a two-transistor oscillator, based on the Robinson principle, will maintain satisfactory sensitivity over a frequency range of at least 5 without adjustment. (auth)

26313 VARIABLE FREQUENCY TRANSMISSION LINE NUCLEAR MAGNETIC RESONANCE SPECTROMETER WITH SERVO-CORRECTION OF BACKGROUND. Scurlock, R. G.; Utton, D. B.; Wilmshurst, T. H. (Univ. of Southampton, Eng.). J. Sci. Instrum., 44: 349-53(May 1967).

The relative advantages of existing methods for observing nuclear magnetic resonance in strongly magnetic materials are reviewed. A practical transmission line spectrometer is described in which certain practical problems, associated with the technique of double-frequency first-derivative recording, are overcome by utilizing a servo system to correct for spurious resonances. Methods were developed to reduce the amount of sample required for a measurement to the order of 10 mg, by using a helically wound center conductor. (auth)

26314 HIGH CURRENT REVERSING SWITCH. (to United States Atomic Energy Commission). British Patent 1,068,274. May 10, 1967. Priority date May 26, 1964, United States.

An electric switch for controlling currents of the order of 2000 A is described. (B.G.D.)

26315 METHOD OF MAKING MAGNETIC CORES. Pears, David Ashley (to Physical Sciences Corp.). British Patent 1,062,276. Mar. 22, 1967. Filed May 7, 1964.

A method of making magnetic cores having substantial constant magnetic characteristics over an extended temperature range where a ferromagnetic chromium–iron alloy of the AISI 400 series is subjected to a plurality of successive thermal shock cycles in each of which the alloy is heated to at least 1000°F for at least one hour and cooled to a temperature below −200°F for at least 5 minutes is described. (B.G.D.)

26316 IMPROVEMENTS IN MAGNETIC TRANSDUCERS. Pears, David Ashley (to Physical Sciences Corp.). British Patent 1,062,277. Mar. 22, 1967. Filed May 7, 1964.

A magnetic transducer is described which comprises a winding embracing a movable magnetic core whose position determines the magnitude of a signal in the winding. (B.G.D.)

26317 IMPROVEMENTS RELATING TO ELECTRONIC BOMBARDMENT APPARATUS. Mulvey, Thomas (to Associated Electrical Industries Ltd.). British Patent 1,066,583. Apr. 26, 1967. Filed May 1, 1963.

An electronic bombardment apparatus is described in which a specimen can be bombarded with a beam of electrons and the result analyzed. The apparatus described is provided with anti-scatter shielding to reduce the amount of background due to secondary electrons. (B.G.D.)

26318 APPLICATIONS IN INDUSTRY AND SCIENCE. 21st Annual ISA Conference Proceedings, Vol. 21, New York, October 24–27, 1966, Part IV. Pittsburgh, Instrument Society of America, 1966. 380p. (CONF-661004–(Pt.4)).

Twenty-eight papers are presented on instrumentation applications in industry and science on an international scale. (B.G.D.)

26319 APPLICATIONS IN INDUSTRY AND SCIENCE. 19th Annual ISA Conference Proceedings, Vol. 19, New York, October 12–15, 1964, Part IV. Pittsburgh, Instrument Society of America, 1964. 420p. (CONF-701–(Pt.4)).

Fifty-four papers are presented on instrumentation applications in industry and science on an international scale. (B.G.D.)

26320 APPLICATIONS IN INDUSTRY AND SCIENCE. 20th Annual ISA Conference Proceedings, Vol. 20, Los Angeles, October 4–7, 1965, Part IV. Pittsburgh, Instrument Society of America, 1965. 430p. (CONF-651002–(Pt.4)).

Eighty-five papers are presented on instrumentation applications in industry and science on an international scale. (B.G.D.)

26321 AVERAGING LIGHT SENSOR AND RECORDING SYSTEM USING DOUBLE PHOTOCELL STRUCTURE. Bell, P. R.; Harris, C. C. (to U. S. Atomic Energy Commission). U. S. Patent 3,322,954. May 30, 1967.

This patent relates to a rescan system for scanning original scan records of radioactive deposits in body tissue or other scan records wherein only one rescan is usually necessary to provide an adequate record for analysis. The system includes a two-field light sensor having a main, central viewing region and an auxiliary, annular viewing region surrounding the central viewing region, and the information reaching the outer sensor area is used to adjust the threshold for the inner sensor area. If the outputs of the two regions are subtracted, it is called the "inhibit" mode of operation, and, with them added, it is the "enhancing" mode of operation. If the outputs of the two regions are multiplied, it is the "cross-correlation" mode of operation. In any event, the combined output of the two-field light sensor, when scanning an original scan record, is a pulse rate proportional to the opacity or transmission, or reflectivity, of this original record and the output is used to make a new or "rescan" record. (auth)

26322 LINEAR PULSE AMPLIFIER (Engineering Materials). (California Univ., Livermore. Lawrence Radiation Lab.). (CAPE-1576).

1 drawing

A linear amplifier is described which is capable of driving 500 μμF and has the following characteristics: 280 to 30,000 gain; input noise, 25 μV base line to peak with 12.5 Ω input; 0.25 or 0.5 μsec (nominal values) rise time; 100 K negative polarity impedance; 50 Ω output impedance; and maximum linear output of 90 V into a maximum 500 μμF (≥ .25 μsec rise). The amplifier may be used with positive input if it follows an inverter. (For details see TID-4100 Suppl. 40). (F.S.)

26323 AUTOMATIC CARBOHYDRATE ANALYZER (Engineering Materials). (Oak Ridge Gaseous Diffusion Plant, Tenn.). (CAPE-1572).

39 drawings

A high-pressure liquid chromatography system is described which is used in separating and analyzing saccharidic compounds in solutions of mixed carbohydrates on a programmable, automatic basis. Sugars obtained from simple extracts or carbohydrate hydrolysates are separated by elution with borate buffers from a strongly basic anion exchange resin in stainless steel columns. The eluate is processed by a phenol sulfuric acid assay and analyzed by a dual wavelength colorimeter equipped with a liquid flow cell. The system can be programmed for the duration and sequence of analytical events. A strip chart recorder presents results of colorimeter analysis of the flowing stream. (For details see TID-4100 Suppl. 40). (F.S.)

26324 IMPROVED CAVITY RESONATOR FOR ATOMIC RESONANCE DEVICES. (to Varian Associates). British Patent 1,067,328. May 3, 1967. Priority date Jan. 28, 1964, United States.

A cavity resonator is described for use in an atomic resonant device so the desired phase relation can be obtained in a cavity resonator which is capable of operating over a relatively wide range of temperatures without substantial detuning effects. (B.C.D.)

26325 IMPROVEMENTS IN AND RELATING TO SPECIMEN CARRIERS FOR ELECTRON MICROSCOPES. (to Commissariat a l'Energie Atomique). British Patent 1,069,354. May 17, 1967. Priority date Jan. 14, 1965, France.

A tension vise for mounting samples for an electron microscope is made up of two jaws, one of which is stationary and forms a support for a pivot, and a second that is articulated to the pivot. At least one heat jack is disposed between the two jaws perpendicular to the pivot axis. A specimen is secured on the two jaws and placed in tension by limited pivoting of the jaws. The jaws form two electrically insulated conductive plates connected by appropriate connections to an electrical resistance operating the heat jack. (B.L.M.)

Radiation Effects on Instruments and Instrument Components

26326 PROTON INDUCED REACTIONS IN LITHIUM-DRIFTED SILICON DETECTORS. Thompson, K. M.; Gruhn, C. R.; Frink, J. (Michigan State Univ., East Lansing). Contract GP-6760. Phys. Lett., 24B: 503-5(May 15, 1967).

The monoenergetic response of lithium-drifted silicon detectors is studied showing the contributions to the tail of the full energy peak resulting from proton induced reactions in the detector. (auth)

LIFE SCIENCES

Biochemistry, Physiology, and Molecular Biology

Refer also to abstracts 26308, 26401, 26409, 26413, 26418, 26440, 26551, 26561, 26562, 26612, and 26668.

26327 (ANL-7220, pp 42-8) STOCHASTIC THEORY OF RECRYSTALLIZATION AND POWER FUNCTION RETENTION. Edgington, David N. (Argonne National Lab., Ill.).

It was found that homotopic (or conventional) exchange reactions governed by self-diffusion of ions in the lattice do not describe the kinetics of ion exchange for close-packed ionic structures. However, heterotopic exchange, which allows surface ions to be buried or lost and causes ions deeper in the lattice to be exposed, can explain the observed shape of the tracer retention curves. The author refers to this process as recrystallization, since it involves remodeling of the solid phase. (auth)

26328 (ANL-7220, pp 68-80) EXCHANGEABLE BONE CALCIUM. Rowland, R. E. (Argonne National Lab., Ill.).

The movement of calcium from blood to bone was studied autoradiographically. Those bone structures with the greatest exposure to the circulating fluids are the primary sites of rapid exchange between blood and bone. These include subperiosteal, endosteal, and trabecular surfaces, and within compact bone, the walls of resorption cavities and Haversian canals. These major exchange sites are not necessarily lowly mineralized; indeed, the vast majority of them are shown by the microradiographs to be at a fairly high level of mineralization. Therefore, it is concluded that lowly mineralized structures are not the major sites of exchange between bone and blood. Quantitation of these autoradiographs has made it possible to measure the quantity of calcium transferred from blood to bone at the various time intervals. It was found that the bone surfaces would be required to exchange an amount of calcium equivalent to that contained within 2000 Å of the bone surface to account for the rapid deposit of ^{45}Ca on these surfaces. This exchange depth was apparently the same in both dog and rabbit bone, but the former required 48 hours to label this volume fully, whereas the latter was fully labeled in only 4 hours. Thus it appears that a significant difference in exchange rates exists between these species. A calculation of the mass of the exchangeable bone calcium in the human skeleton, made on the basis of this autoradiographically-determined exchange depth of 2000 Å, yields a value of 6.5 grams, in remarkable agreement with the generally accepted value of 5 grams. It would thus appear that these autoradiographic techniques have definitely located the source of the rapidly exchangeable calcium in bone. (auth)

26329 (CEA-R-3107) RESULTATS EXPERIMENTAUX RELATIFS AU METABOLISME DE L'IODE 131 INGERE CHEZ LA BREBIS ADULTE EN LACTATION. (Experimental Results Concerning the Metabolism of Ingested ^{131}I in Adult Sheep During Lactation). Daburon, Francois; Capelle, Albert; Tricaud, Yves; Nizza, Pierre (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Jan. 1967. 68p. (In French). Dep. mn.

Results are reported from a series of experiments on the metabolism of ingested iodine-131 in adult sheep under lactation. The work was concerned initially with the fixation of iodine-131 in the thyroid gland, with the calculation of radiation doses absorbed and with ways of showing up any possible radiation damage in the gland. The modes of absorption of iodine-131 and its elimination through milk, urine, and feces were then considered, and changes in the radioactivity of the blood and of the milk, variations of the PBI level of the blood serum, and different methods for measuring this level are discussed. (auth)

26330 (N-67-11851) PHYSICS OF CELLULAR SYNTHESIS, GROWTH, AND DIVISION. Progress Report, April 1-September 30, 1966. (Pennsylvania State Univ., University Park. Dept. of Biophysics). Nov. 7, 1966. 21p. (NASA-CR-79921). CFSTI $3.00 cy, $0.65 mn.

Brief summaries are presented of the following research: (1) CaCl density gradient centrifugation of intact bacterial cells; (2) hydrostatic pressure effects on macromolecular synthesis; (3) centrifugal effect on macromolecular synthesis of E. coli; (4) reversion of mutagens; (5) hydrogen atom-amino acid interaction; (6) dose saturation in gamma-irradiated organic solids; (7) radiation effects on thymine and related purine derivatives; (8) free radical production by decay of tritium in nucleic acid pyrimidines; (9) photodynamic action at the molecular level; (10) breaks in DNA; and (11) bacterial growth in high sugar concentrations. (C.O.)

26331 (NYO-918-16) PROGRESS REPORT [ON STEROID STUDIES], MAY 1, 1966-APRIL 30, 1967. Pincus, Gregory (Worcester Foundation for Experimental Biology, Shrewsbury, Mass.). Contract AT(30-1)-918. 28p. Dep. CFSTI.

Progress is reported on studies on the effects of irradiation on steroid metabolism. Data are presented on techniques for the preparation of ^{14}C- or tritium-labeled steroids; the development of methods for the analysis of blood plasma and urine for steroids; studies of steroid metabolism in rat adrenals and testes; the biosynthesis of aldosterone in sheep adrenals; steroid secretion by sheep ovarian autotransplants; determinations of the metabolic clearance rates of estradiol and estrone in menstruating females and normal males; and the development of an automated paper chromatography method for the determination of steroids in urine. The method was tested on a large number of urine samples from patients with breast cancer, patients suffering from stroke, and healthy elderly subjects. Results are included from preliminary studies on the effects of x irradiation on steroid metabolism in guinea pigs. (C.H.)

26332 (ORO-3554-1) QUANTITATIVE STUDIES OF RADIATION EFFECTS ON THE INCISOR TEETH OF RATS. Progress Report, June 1, 1966-February 28, 1967. Willhoit, Donald G. (North Carolina Univ., Chapel Hill. Dept. of Environmental Sciences and Engineering). Contract AT(40-1)-3554. 21p. Dep. CFSTI.

Progress is reported on a study of dose-response relations of various radiation response parameters of the incisor teeth of rats. Specifically, the aims of the research were to study the effect of different doses of x irradiation on deoxyribonucleic acid synthesis and migration of odontogenic and amelogenic tissues using tritiated thymidine as a label; tracer studies on the effect of different doses of x irradiation on the mineralization pattern of the rat incisor tooth; development of techniques for expressing gross macroscopic manifestations of radiation exposure as specific endpoints; and expression of the dose-response relations of these endpoints in relation to a series of radiation exposures. Data are presented from studies on the uptake and distribution of P-32 by the incisor teeth of rats exposed to various doses of x radiation. (C.H.)

26333 (TID-23802) RADIATION DAMAGE TO THE ELECTROCHEMICAL AND BIOCHEMICAL ACTIVITIES OF MUSCLE MEMBRANE. Progress Report. Portela, Adolfo; Perez, Juan Carlos (Buenos Aires Univ. (Argentina). Facultad de Ciencias Medicas). July 1, 1965. Contract AT(30-1)-3467. 36p. DTIE.

Preliminary studies are reported on radiation effects on properties of the muscle cell with emphasis on the cell membrane. The present report is concerned with the following aspects of this research: potassium and cesium effects on sodium efflux (using ^{22}Na) and oxygen consumption; action of trypsin in the presence of cesium- or potassium-Ringer upon the resting membrane potential; acetylcholine(^{14}C) release in potassium-repolarization; and relation of threshold and tension in muscle fibers. (H.L.W.)

26334 THE EFFECT OF HEATING AND γ-IRRADIATION ON THE ENZYME ACTION SUSCEPTIBILITY OF EGG WHITE PROTEINS. Kurokawa, Kazuo. Eiyo To Shokuryo, 18: 187-9(1965). (In Japanese).

Heat-coagulated egg white proteins are digested at 37°C for 30 minutes by pepsin and trypsin. Susceptibility of egg white proteins to pepsin was not affected by heating of proteins, while that to trypsin was increased with increasing temperature of heat treatment. When egg white proteins were heated and then irradiated with ^{60}Co gamma rays, no dose effect was found for their susceptibility to pepsin and trypsin. In the case of post treatment by heating, there was no temperature effect on the susceptibility to the pepsin action. Considerable combined effects of irradiation and post-heating on the susceptibility to trypsin were observed. (auth)

26335 ON THE CHEMICAL STATUS OF DEOXYRIBONUCLEIC ACID IN BACTERIAL NUCLEOIDS. IV. COMMUNICATION ON NUCLEOIDS. Fuhs, G. Wolfgang (New York State Dept. of Health, Albany). Arch. Mikrobiol., 52: 91-100(Sept. 6, 1965). (In German).

Electron microscopic and chemical studies were performed on the interaction of uranyl ions with the nucleoids of Bacillus subtilis, Escherichia coli, and Rhodospirillum rubrum and with DNA solutions. The limiting concentration of uranyl ions that was necessary for induction of a fibrillar appearance in bacterial nucleoids, as observed in ultrathin sections, was decreased markedly by pretreatment of the cells with solutions of uranyl salt and subsequent removal of uranyl ions by ethylene diaminetetraacetate (EDTA), and to a lesser extent by pretreatment with EDTA alone. If the pretreatment was followed by application of a mixture of Ca and Mg ions and polyamines, its effect was largely reversed. In in vitro experiments the association of uranyl ions with DNA was studied in detail. The results indicated that uranyl ions displace ligands from the phosphate groups of intracellular DNA that are partly (as far as they are removed by EDTA alone) divalent metal ions with the remainder being of organic nature and possibly of low molecular weight. The effect of uranyl ions on nucleoid structure was apparent when about 50% of the phosphate groups of DNA were neutralized by uranyl ions. (BBB)

26336 EFFECTS OF ULTRAVIOLET LIGHT ON POLYURIDYLIC ACID ASSAYED IN VITRO. **Logan, D. M. (National Inst. of Arthritis and Metabolic Diseases, Bethesda, Md.); Whitmore, G. F. J. Mol. Biol., 21: 1-12(Oct. 1966).**

Ultraviolet irradiation of polyuridylic acid reduced the template activity of the polynucleotide in cell-free protein synthesis. This effect was previously ascribed to changes in the recognition codon. Ultraviolet radiation also changed both the extent of degradation of added polyuridylic acid messenger and its interaction with ribosomes and ribosomal subunits. Radiation doses leading to optical density losses exceeding 60% rendered the polyuridylic acid insensitive to degradation by Escherichia coli nucleases. In addition, at doses of similar magnitudes and beyond, the binding of polyuridylic acid to ribosomes was reduced and eventually eliminated. It was suggested that these effects may arise from an increased secondary structure in the polyuridylic acid due to the presence of uv photoproducts in the polynucleotide. (BBB)

26337 LOCALIZATION OF ANTI-BRAIN RADIOANTIBODIES IN RAT BRAIN. **Day, Eugene D.; Rigsbee, Lewis; Wilkins, Robert; Mahaley, M. Stephen Jr. (Duke Univ., Durham, N. C.). Contract AT(40-1)-3195. J. Immunol., 98: 62-6(Jan. 1967). (ORO-3195-02).**

Brain localization of intravenously (IV) and intracerebrally (IC) injected radioantibodies and normal radioglobulin in rats was investigated. Cross-localizing antibodies that remained in the brain when IC injected but localized primarily in other normal tissue when IV injected were used to test the concept that the blood-brain barrier to radioglobulin is a dynamic equilibrium whose equilibrium constant favors general circulation by several orders of magnitude. This concept explains why IC injected normal radioglobulin achieved the same general bodily distribution as IV injected normal radioglobulin. Passive transfer of ^{125}I-labeled antibrain antibody paired with ^{131}I-labeled normal globulin for 2 hr, in normal rats, subsequent IV transfer of serum-borne radioglobulins to normal recipient rats for another 24 hr illustrated a specific brain-localizing antibody that was detected in minute but significant amounts. (BBB)

26338 AUTOMATION OF BLOOD GROUP DETERMINATIONS USING RADIOACTIVELY LABELLED ANTIBODIES. **Hughes-Jones, N. C. (Medical Research Council, London). Bibl. Haematol., 23: 992-6(1965).**

A new automated method for determining blood group specificity employing radioiodine is presented as well as directions for preparing highly purified radioiodine-labeled antibodies. The basis of the method is the addition of an excess of red cells to the purified radioactively labeled antibody. If the cells contain the appropriate antigen, they will react with the antibody and on separation of the cells and supernatant the radioactivity will be found with the cells. If the antigen is not present, the radioactivity will remain in the supernatant. The success of this method depends on the production of purified radioiodine-labeled antibody, that is, the radioactivity present in the antibody solution is bound only to antibody and not to other nonantibody proteins. The first step in the preparations of pure antibody was to obtain the 7S γ-globulin fraction from a serum containing the antibody and to label this with radioiodine. Purification was achieved by adsorbing the labeled antibody onto red cells of the appropriate blood group and then eluting it off again. When these iodine-labeled antibodies were used for the determination of blood groups, the conditions were so arranged that on the addition of red cells containing the appropriate antigen to the antibody solution, almost all the labeled antibody was adsorbed by the cells and almost none was left free in solution. The optimal conditions for this process were derived from a consideration of the theoretical aspects of the reaction. An advantage of using radioactively labeled antibodies was that two antibodies of different specificity could be used at the same time. Thus anti-A could be labeled with ^{125}I and anti-B with ^{131}I. These 2 isotopes can be distinguished with a 2-channel analyzer. Thus, the two antibodies can be mixed together in one solution and the ABO specificity determined at one operation. (BBB)

26339 ENZYME INACTIVATION BY ULTRAVIOLET LIGHT AND PROTECTIVE EFFECT OF MELANIN. **Seiji, Makoto; Iwashita, Sadao (Juntendo Univ., Tokyo). J. Biochem. (Tokyo), 57: 457-9(Mar. 1965).**

Whether melanin has a protective effect on enzymes against in vitro uv irradiation was investigated to clarify the mechanism of the protective effect of melanin in the skin. Mouse melanoma was homogenized in 0.25 M sucrose and the large-granule fraction of the melanoma and the mitochondrial fraction of mouse liver were prepared. Melanosomes were obtained from the large-granule fraction that was isolated from melanoma by density gradient centrifugation. Tyrosinase, ATPase, and acid phosphatase activities of both melanosomes and smooth-surfaced membranes which had been irradiated with uv light were determined. Tyrosinase, ATPase, and acid phosphatase activities of smooth-surfaced membranes decreased with increasing doses of uv; the activities of these enzymes in melanosomes showed no change. When melanin was present in the reaction mixture, degeneration from uv exposure did not occur, probably because the uv energy was trapped by the melanin. Succinate dehydrogenase of liver mitochondria was inactivated by uv irradiation. When melanosomes, which contain melanin, were mixed with mitochondria, the degree of succinate dehydrogenase inactivation was much lower. Results supported the concept that melanin contained in the melanosome protects enzymes against uv radiation. (BBB)

26340 ACTIVITY OF FIBRINASE IN RATS IRRADIATED WITH γ-RAYS. **Baluda, V. P.; Polushkin, B. V.; Rukazenkova, Zh. N.; Khnychov, S. S. (Inst. of Medical Radiology, Obninsk, USSR). Byull. Eksp. Biol. Med., 62: No. 8, 30-2(Aug. 1966). (In Russian).**

Rats of the August strain were used to study the activity of fibrinase (Lacki-Lorand's fibrin-stabilizing factor) in acute radiation sickness. The latter was induced by a single total irradiation with ^{60}Co γ rays in a dose of 600 and 3,000 R at dose intensity of 88 R/sec. Under the influence of penetrating radiation the activity of fibrinase falls, while the structure and properties of the fibrin clot become disturbed. A reduction in fibrinase activity is observed as early as 24 hrs after the irradiation of animals. It is most pronounced at the height of the disease. At 3,000 R the changes are more obvious. Disturbance of the blood clot structure caused by a reduction in fibrinase activity may be important in the pathogenesis of bleeding during radiation sickness. (auth)

26341 RADIOIODINE UPTAKE STUDIES OF THE HUMAN FETAL THYROID. **Evans, Titus C.; Kretzschmar, Robert M.; Hodges, Robert E.; Song, Chang W. (Univ. of Iowa, Iowa City). J. Nucl. Med., 8: 157-65(Mar. 1967).**

Thyroidal uptake of ^{131}I in 36 human fetuses was studied. There was no detectable uptake before the third month. From the third to the fourth month the uptake varied from 0.001 to 0.04% per gland with an average of 0.025, or approximately 1% per gram of thyroid. During the next month, the per cent per gland averaged 0.2 and the percent per gram of thyroid averaged almost two. The highest concentration was 5% per gram for the five to six month period. During this time, the uptake per gland was about 1%. Near term, the percent per gland increased to two, but the concentration was less than at the sixth month. The maximum concentration was about five times that of the adult thyroid, but this concentration is much lower than that found for the first few days after birth. (auth)

26342 RATE OF PASSAGE OF ^{45}Ca AND ^{91}Y ALONG THE INTESTINE, AND CALCIUM ABSORPTION IN THE LAYING FOWL. **Hurwitz, S.; Bar, A. (Volcani Inst. of Agricultural Research, Rehovoth, Israel). J. Nutr., 89: 311-16(July 1966).**

The passage times and sites of effective absorption of ^{45}Ca and ^{91}Y in the intestine of laying fowl were determined by comparing the recovery of the isotope with its progress through the intestine and by measuring the concentration of the isotope in plasma following the delivery of a single dose into the duodenum. Passage time in the crop and along the intestinal tract was similar for both isotopes, but ^{45}Ca appeared to have moved more rapidly than ^{91}Y out of the stomach. The passage rate was highest in the duodenum and progressively decreased through the intestine. Outflow of ^{45}Ca from the intestine to the blood was rapid during the first 30 min after duodenal administration: at this time the isotope had partially moved beyond the jejunum; the outflow into plasma appeared to slow down. It was concluded that the most effective site of Ca absorption in the laying hen was the jejunum. (TSS)

26343 METABOLISM OF RADIOACTIVE CYCLOPHOSPHAMIDE. ANIMAL TESTS AND CLINICAL STUDIES. **Graul, E. H.; Schaumloeffel, E.; Hundeshagen, H.; Wilmanns, H.; Simon, G. (Univ., Marburg, Ger.). Cancer, 20: 896-9(May 1967).**

Results are presented from animal tests and clinical studies on the metabolism of radioactive cyclophosphamide (Endoxan). The authors conclude that most of the metabolic breakdown of Endoxan occurs within the first two to three hours after administration. Further radiochromatographical investigations must be undertaken before the distribution of cytostatically active metabolites and their concentration in the tumor tissue can be elucidated. Studies on cerebral tumors have shown that the concentration is probably higher in the peripheral zones of the tumor than in the center. (auth)

26344 CHARACTERISTIC OF DNA ACCUMULATED IN APPENDIX TISSUE OF RABBIT AFTER IRRADIATION. Ermolaeva, N. V. Vop. Med. Khim., 8: 115-20(Mar.-Apr. 1967). (In Russian).

Chromatography of DNA salt extracts isolated from lymphoid tissue of the appendix after irradiation of rabbits was carried out on DEAE-Sephadex. In extracts that were subjected to deproteinization purification from RNA and low molecular weight products the main part of DNA was eluted from DEAE-Sephadex by 0.8M NaCl. Characteristic viscosity of DNA in purified extracts received in 3 and 6 hours after irradiation was 3.0 to 3.2 dl/g. It shows that DNA from extracts of appendix of irradiated rabbits is not high-polymeric. (auth)

26345 SIMPLE METHOD FOR ESTIMATING BLOOD CHOLINESTERASE. Winteringham, F. P. W.; Disney, R. W. (Agricultural Research Council-Pest Infestation Lab., Slough, Eng.). Lab. Pract., 13: 739-40(Aug. 1964).

A new radiometric method is described by which acetylcholinesterase activity can be determined at low substrate concentrations and with minimal sample dilution. It is more sensitive than conventional methods for indicating cholinesterase inhibition by compounds such as insecticidal carbamates which behave as reversible inhibitors. The availability of 1-^{14}C-acetylcholine, at higher sp act. than that originally employed, enabled the field procedure to be simplified. As described, it provides for a simple and rapid indication of cholinesterase activity of small blood samples. The average result for a human blood sample was found to be 130 μmole per hr per ml at 25°C with a coefficient of variation ±5.4%. The enzymic hydrolysis rate observed depends upon the effective temperature of the assay. (BBB)

26346 RADIOIODINE UPTAKES IN THE THYROID STUDIES OF THE BLOCKING AND SUBSEQUENT RECOVERY OF THE GLAND FOLLOWING THE ADMINISTRATION OF STABLE IODINE. Ramsden, D.; Passant, F. H.; Peabody, C. O.; Speight, R. G. (Atomic Energy Establishment, Winfrith, Eng.). Health Phys., 13: 633-46(June 1967). (AEEW-R-444).

In a series of experiments during 1964 small quantities of radioiodine were given to nine volunteers and their thyroid uptakes and urinary excretion patterns studied. The effects of varying doses of stable iodine on these patterns were investigated. Models of the thyroid metabolism were slightly amplified to give satisfactory explanations of the experimental results. The minimum amount of stable iodine needed to block the thyroid uptake completely was about 30 mg. Thyroid uptake ceased within half an hour of taking the blocking dose, and was back to normal about 8 days after the intake. Repeated doses of stable iodine may be given at intervals to maintain effective blocking of the gland. The required doses range from 35 mg every 12 hr to 250 mg every 48 hr. (auth)

26347 RADIOCHEMICAL STUDIES OF SOME AMINO ACID AND PEPTIDE SOLUTIONS. Sultanov, A.; Khalikov, D. R.; Ibragimov, A. P. Uz. Biol. Zh., No. 1, 3-6(1967). (In Russian).

Effects of ^{60}Co γ radiation of 500 rad/sec on 0.05M solutions of various aminoacids and dipeptides were studied in order to determine the mechanism of radiation effects on the albumin in cells and fluids of an organism. Tabulated data are given on the yield of $>C=O$ and H_2O_2 in amino acids at 3.5×10^5 rad and for the $>C=O$, NH_3, and H_2O_2 yield in irradiated dipeptides. (R.V.J.)

26348 BRIEF OBSERVATIONS ON THE DISTRIBUTION AND BIOLOGICAL ACTION OF RADIOACTIVE ISOTOPES. Granone, F. G. (Univ., Turin). Minerva Radiol., Fisioterap. Radiobiol., 11: 604-8(Nov. 1966). (In Italian).

Within certain limits, examination of experimental data offers trustworthy criteria for the interpretation and anticipation of phenomena observed in human pathology. On the basis of experimental data reported in the literature, the relation between the distribution and the biological action of some radionuclides are examined also with regard to their blastic potency. (auth)

26349 EXTRATHYROIDAL THYROXINE FORMATION IN COMPLETELY THYROIDECTOMIZED RATS. Taurog, Alvin; Evans, Edward S. (Univ. of Texas, Dallas. Univ. of California, Berkeley). Endocrinology, 80: 915-25(May 1967).

Thyroidectomized rats were injected daily with 5 mg of (K or Na) iodide for 2–4 weeks, a treatment shown in many previous experiments to have a marked thyromimetic effect on growth and other biological processes. Control thyroidectomized rats received simultaneously either NaCl or 5 μg of iodide. Together with the last 3 or 7 injections, ^{131}I was also administered in a daily dose of 500 μc to both experimental and control groups. Plasma obtained 12 to 24 hr after the last injection was dialyzed to remove ^{131}I, and concentrated butanol extracts were subjected to paper chromatography in 2 or 3 different solvents. Scans of the paper chromatograms prepared with plasma from the rats that received 5 mg of iodide daily showed unequivocal peaks corresponding to added T_4 carrier in 5 of 8 experiments. Such peaks were not observed on corresponding chromatograms from the control rats. It was estimated that the rats injected with large doses of iodide produced sufficient T_4 to maintain a plasma level as high as 13–25 m μg T_4/ml, based on the assumption that the specific activity of ^{131}I in the circulating T_4 was equal to that of the injected iodide. Evidence is presented that at least 50% of the thyroidectomized rats selected for iodide injection were completely devoid of thyroid tissue. Since, under suitable conditions, the biological response to injected iodide occurs in 100% of the treated animals, it does not seem likely that residual thyroid tissue plays a role in the thyroxine-like action of iodide. Other evidence is also cited for this view. We conclude that thyroxine is formed at some extra-thyroidal site(s) in thyroidectomized rats injected daily with 5 mg of iodide. The site(s) and mechanism of the reaction remain to be elucidated. (auth)

26350 THE BIOLOGICAL BEHAVIOUR OF MOTHER AND DAUGHTER SUBSTANCES AFTER INCORPORATION OF ^{90}Sr–^{90}Y IN RATS. Steinbach, K. H. (Heiligenberg-Institut, Baden, Ger.). Atompraxis, 12: 599-603(Dec. 1966). (In German).

The varying distribution of ^{90}Sr and ^{90}Y in various organs of the rat following intravenous injection of a balanced solution was examined. The Y/Sr activity ratio was calculated from values measured in the femur, liver, kidney, spleen, heart, brain, and skin at two different times. In all the organs there was a steep increase in the ratio values during the first few days after injection. After passing through a maximum between the 2nd and 4th day postinjection the values returned to their initial state of equilibrium. There were marked differences in the maximal values found in the various organs, in the following decreasing order: liver, kidney, spleen, heart, skin, brain, and femur. (auth)

26351 THE INFLUENCE OF DIMERCAPTOPROPANOL (BAL) ADMINISTRATION ON THE RENAL ELIMINATION OF RADIOACTIVE MERCURIALS IN MAN. Martinenghi, C.; Riccardi, A.; Roncari, G.; Morvillo, V. (Univ., Milan). Acta Isotop., 6: 25-43(Sept. 30, 1966). (In Italian).

The elimination of radiomercury introduced intravenously into the body in tracer doses, under the form of Chlormerodrin, using dimercaptopropanol (BAL) was studied in man. Observations made through external measurements of the radioactivity values in the renal site, allowed assessment of differences in the radionuclide excretion rate between the two groups of patients, one of which served as controls. The other group was treated with the chelating agent. The differences were less apparent than those seen in the rat. Analysis of the radioactivity curve permits formulating some hypotheses about the action mechanism of BAL. Comparison of the progressive definite integrals of the radioactivity curves in the two groups offers an index of the efficiency of the chelating agent in reducing the absorbed dose when using an isotope of slow physical decay, such as ^{203}Hg, or one of brief half life, such as ^{197}Hg. (auth)

26352 THERMAL AFTER-EFFECT OF ULTRAVIOLET IRRADIATED LACTATE DEHYDROGENASE OF RABBIT MUSCLES. Kurganov, B. I. (Inst. of Biological Phys., Moscow). Biophysics (USSR) (Engl. Transl.), 10: 966-9(1965).

Translated from Biofizika, 10: 875-6(1965).

The thermal after-effects of uv-irradiated lactate dehydrogenase, an enzyme having on denaturing a concentration order of less than unity, were studied. On thermal denaturing of LDH the specific initial rate of denaturing v_0 (initial rate related to the unit concentration) rose with reduction in the initial concentration of enzyme, i.e., the concentration order of the reaction was less than unity. For uv-irradiated protein v_0 also rose with fall in the concentration of active enzyme; irradiated protein denatured more rapidly than native. The degree of increase in the initial rate of denaturing of LDH after irradiation was the same for concentrations of active enzyme of less than 1.0 mg/ml. It was further found that irradiation results in formation of products accelerating denaturing of native protein, an effect that depends on the time of irradiation. Acceleration of the process of thermal denaturing after irradiation is connected therefore both with formation of latent-damaged protein and with the appearance in the irradiated protein of substances of an unknown nature that accelerate denaturing of the active enzyme remaining after irradiation. Other experiments showed that LDH inactivated by heat has little, if any, influence on the rate of denaturation of native protein. (H.G.D.)

26353 RADIOAUTOGRAPHIC LOCALIZATION OF THE INCREASED SYNTHESIS OF PHOSPHATIDYLINOSITOL IN RESPONSE TO PANCREOZYMIN OR ACETYLCHOLINE IN GUINEA

PIG PANCREAS SLICES. **Hokin, Lowell E.; Huebner, Dorothy (Univ. of Wisconsin, Madison). J. Cell Biol., 33: 521-30(June 1967).**

A technique is described for measuring the incorporation of myo-inositol-2-^{3}H into the lipid of various regions of the guinea pig pancreatic acinar cell by radioautography. Stimulation of enzyme secretion with either pancreozymin or acetylcholine was associated with increased graining in both the basophilic cytoplasm and the nonbasophilic cytoplasm. Kinetic studies suggested that the incorporation of myo-inositol-2-^{3}H was stimulated independently in the two regions. Most of the increment in graining due to stimulation with pancreozymin or acetylcholine plus eserine was abolished if the tissue was extracted with 2 : 1 chloroform–methanol before radioautography. On chromatography of lipid extracts of pancreas, the only lipid showing a detectable increment in radioactivity on stimulation with pancreozymin was phosphatidylinositol. Thus, essentially all of the increment in graining is likely to be due to increased incorporation of tritium into phosphatidylinositol. These studies, coupled with earlier studies employing differential centrifugation, indicate that on stimulation of enzyme secretion there is increased synthesis of phosphatidylinositol in the rough-surfaced endoplasmic reticulum and in the smooth-surfaced Golgi membranes. The significance of these observations is discussed in connection with membrane circulation presumed to occur in the pancreatic acinar cell on stimulation of protein secretion. It is suggested that the increased synthesis of phosphatidylinositol may be concerned with the formation of new endoplasmic reticulum and possibly Golgi membrane to replace that which is presumably converted to membrane of the zymogen granules during intracellular protein transport. (auth)

26354 POSSIBILITY OF PROVING AN APPLIED IRRADIATION OF MEAT. Rumpf, G. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). Atompraxis, 12: 613-17(Dec. 1966). (In German).

Samples of beef and pork were x-irradiated with doses of 0.03 to 3 mR in air-tight packages. After extraction with water, absorption spectra of the extracts were recorded in the visible region. In beef a sharp increase in the formation of the green pigment sulfomyoglobin was noticed between 0.1 and 1 mR. Possibilities are shown for a quantitative and qualitative evaluation of this effect as a means of estimating a possibly applied dose or radiation in fresh beef. With pork no pronounced formation of sulfomyoglobin was noticed at up to 3 mR. On the basis of model experiments the greater radiation resistance of the myoglobin in pork is interpreted as a result of a higher radiation resistance of the S-containing amino acids in the protein portion. (auth)

26355 THE INFLUENCE OF NOREPINEPHRINE ON THE DISTRIBUTION OF RADIOACTIVITY FROM SOME OF ITS ^{14}C-LABELED ANALOGUES AND PRECURSORS. Gordon, Malcolm W.; **Deanin, Grace G.; Hanson, Rolf K. (Inst. of Living, Hartford, Conn). Biochem. Pharmacol., 16: 793-802(May 1967).**

The influence of slowly infused norepinephrine on the distribution of radioactivity from a group of structurally different ^{14}C-labeled compounds was examined. In short-term experiments it was shown that small amounts of norepinephrine stimulate the uptake of radioactivity in heart and brain from those compounds that are structurally analogous or biosynthetically related to norepinephrine. No such stimulation was observed in liver or kidney, nor was the stimulation apparent in any organ, including brain and heart, with compounds not bearing either of these relationships to norepinephrine. The effects of norepinephrine on the uptake of radioactivity from its analogues in heart and/or brain persisted even when the circulatory impact of norepinephrine was minimized by pretreatment with chlorpromazine. When large circulatory changes were deliberately produced, norepinephrine still had no specific effect on the distribution of radioactivity from unrelated compounds. Some possible relations between a norepinephrine-sensitive transport system and the regulation in vivo of extracellular norepinephrine and its analogues are discussed. (auth)

26356 STIMULATION OF THYROIDAL RADIOIODINE UPTAKE BY ACTINOMYCIN D AND FLUOROURACIL. AN INDIRECT EFFECT. **Rodesch, F.; Rocmans, P.; Dumont, J. E. (Univ. of Brussels). Biochem. Pharmacol., 16: 907-8(May 1967).**

Studies are reported that show that increased thyroidal uptake of ^{125}I in mice treated with actinomycin or fluorouracil is caused mainly by the reduced ability of the mice to eat iodine-rich food. A behavioral explanation is given of the enhancement of the effect when control and experimental mice are housed in the same cages. (H.G.D.)

26357 PHYSICOCHEMICAL INVESTIGATION OF THE MECHANISM OF INACTIVATION OF ENZYMES. I. THERMO-INACTIVATION OF MYOSIN AND PEPSIN BOTH INTACT AND AFTER EXPOSURE TO RADIATION. **Ganassi, E. E.; Zarkh, E. N.; Kondakova, N. V.; Eidus, L. Kh. (Inst. of Biological Physics, Moscow). Biophysics (USSR) (Engl. Transl.), 10: 1068-76(1965).**

Translated from Biofizika, 10: 966-73(1965).

The kinetics of thermo-inactivation of intact enzymes were investigated in myosin and pepsin. Because of the wide range of temperatures investigated corresponding to the variation in the rate of reaction (k) by a factor of 100 (pepsin) and by a factor of 1000 (myosin), a break was found in the curve of the Arrhenius function log k = f(1/T) indicating the complex character of this process. A method was described for analyzing the reaction of thermal after-effect in irradiated proteins and the results of measurements of the rates of activation energies given for enzymes subjected to γ- and ultraviolet radiation and a photodynamic effect. (auth)

26358 EFFECT OF SUPERWEAK INTENSITIES OF ULTRAVIOLET RADIATION ON CELL DIVISION AND GLYCOLYSIS. **Konev, S. V.; Lyskova, T. I. (Lab. of Biophysics and Isotopes, Minsk, USSR). Biophysics (USSR) (Engl. Transl.), 10: 1102-5 (1965).**

Translated from Biofizika, 10: 1000-2(1965).

A synchronized culture of yeast cells (Torula utilis) was used to investigate the possibility of uv-induced physiological change in a cell consisting of 10^{14} to 10^{15} molecules by conversion of a single molecule to an electron excited state. Results indicated: the possibility of inducing mitosis by one or more quanta; that such induction would occur only in cells potentially ready for division; and the existence of a secondary chain mechanism for transmission of the stimulus for division from cell to cell over large distances. Stimulation of glycolysis in yeast cells by uv radiation in mutagenic doses was approximately twofold. (H.G.D.)

26359 ON THE BEHAVIOR OF IRRADIATED "SNAIL ENZYME". Katona, E. (Univ., Zurich). Radiol. Clin. Biol., 35: 305-10(1966).

Snail extract (or snail enzyme, extracted from Helix pomatia), was dissolved in water and in two different buffer systems (pH 5.8 and 6.8) in concentrations of 10 and 0.1%. The spectrophotometric behavior of the solutions, and their lytic activity on the cell wall of Schizosaccharomyces pombe was studied before and after x irradiation. Irradiation of the 10% solution (necessary concentration for lytic activity) up to 1 million R had no effect on the biological activity of the extract. When this solution was diluted to 0.1% absorption spectrum was same as for non-irradiated solutions. The 0.1% solution when irradiated showed a hypsochromatic effect combined with hyperchromacy, only from 200,000 or more R. (auth)

26360 DISTRIBUTION OF ^{65}Zn IN PEAR TREES FOLLOWING BARK INJECTION. **Millikan, C. R.; Hanger, B. C. (Victorian Plant Research Inst., Burnley, Australia). Austral. J. Agr. Res., 18: 85-93(1967).**

Two-yr-old pear trees (Packham Triumph variety) growing in 15-gal drums, were bark-injected with ^{65}Zn 2 months after bud burst. To some injection doses nonradioactive zinc with or without ethylenediaminetetraacetate (EDTA) was also added. The ^{65}Zn only moved from the injection point when extra Zn was included in the dose. EDTA further enhanced this movement. The ^{65}Zn was distributed to spurs and laterals on the injected leader, situated above and on the same side as the point of injection. Limited downward movement was also evident. The ^{65}Zn was detected in new growth formed after injection, and also in blossom, leaves, and new lateral growth produced on the injected leaders in the following season. It was found that ^{65}Zn accumulated at the nodes on laterals, and in the petioles, midrib, and major veins of the leaves. (BBB)

26361 EOSINOPHIL GRANULES AND URANYL ACETATE AN ELECTRON MICROSCOPE STUDY OF GUINEA-PIG BONE MARROW. **Hudson, G. (Univ. of Bristol, Eng.). Exp. Cell Res., 46: 121-8(Apr. 1967).**

The specific granules of eosinophil leukocytes were investigated by means of electron microscopy. After staining with uranyl acetate, by various methods, the appearance of the granule-externa was consistently one of moderate and fairly uniform density, but that of the granule-interna showed a number of variations. Relative to the general density of the tissue, an internum might show either a uniform and high density, a peripheral rim of high density with a less dense central area, or a fairly uniform and low density, thus appearing paler than the surrounding externum. The frequency with which any of these appearances was encountered seemed to be related to the method used for staining; variations were not infrequently seen among the granules of a single cell. Possible interpretations are considered and implications as to the physical properties of the granule-internum are discussed. (auth)

26362 STUDIES ON ERYTHROPOIESIS IN CANCER PATIENTS USING RADIOACTIVE IRON AND CHROMIUM. Dunjic, A.; Demuynck, G.; van de Merckt, J. (Institut du Cancer, Louvain, Belg.). J. Belge Radiol., 50: 78-95(1967). (In French).

Red cell survival and erythropoietic activity was studied in 24 patients with leukemia or cancer by means of radiochromium and -iron. In 18 cases both tests were performed simultaneously: 3 further patients were submitted to the ^{59}Fe test only, 2 to the ^{51}Cr test and 1 underwent a ^{51}Cr test first and ^{55}Fe exploration afterwards. In 4 out of 21 cases peripheral hemolysis was observed by the ^{51}Cr test. The ^{59}Fe test showed 4 patients to have erythropoietic activity within normal limits; 9 showed increased, and also 9 reduced erythropoiesis. These results are discussed in connection with the mechanism proposed in the literature to account for the appearance of anemia in neoplasic diseases. Simultaneous use of ^{51}Cr and ^{59}Fe for determination of red cell survival, plasma, and red cell turnover of ^{59}Fe and fixation of the isotopes in the organs has far greater value than the exploration by either ^{51}Cr or ^{59}Fe alone, especially when the possibilities of the latter tests are not exhaustively used. (auth)

26363 UPTAKE, TRANSFER, AND LOSS OF ^{32}P DURING METAMORPHOSIS, MATING, AND OVIPOSITION IN AEDES VEXANS. Quraishi, M. Sayeed; Brust, R. A.; Lefkovitch, L. P. (Univ. of Manitoba, Winnipeg, Can.). J. Econ. Entomol., 59: 1331-3(Dec. 1966).

As a prelude to field studies, the most minute quantity of ^{32}P necessary for detection of adult Aedes vexans from ^{32}P-labeled eggs and larvae was determined. Amounts of ^{32}P concentrated in reproductive organs of the male, transferred to the female from the male during copulation, and deposited in eggs by the female were also determined. At 72 hours, uptake of ^{32}P by fourth instar larvae was significant; uptake was very rapid during the first 24 hour period. Measureable amounts of ^{32}P were transferred from the male to the female during induced copulation. Females deposited appreciable amounts of ^{32}P in the egg; the percentage of ^{32}P in batches of eggs was found to be 13.3. The mean average of ^{32}P in an egg, expressed a proportion of the total radioactivity of the female prior to oviposition, was 0.369%. However, as the number of eggs laid by a female in a given batch increased, the proportion of radioactivity in each egg decreased. From these results, the amount of radioactivity necessary for detection of an adult or an offspring from a tagged larvae can be established; thus, exposure of insects to high levels of activity can be avoided. (TSS)

26364 ATOMIC ENERGY IN LIFE SCIENCES. Gopal-Ayengar, A. R. (Atomic Energy Establishment, Trombay, India). At. Energy Rev., 4: Commemorative Issue, 59-71(Dec. 1966).

In surveying the impact of atomic energy on the life sciences, the author discusses particularly the various uses of isotopes in biology and biochemistry, instancing in some detail the effectiveness of tracers as a research tool. He touches on such subjects as the use of isotopes in revealing the processes of plant growth and nutrition, in eradicating insect pests, in improving agriculture and in promoting health and combating disease, and calls for a concerted effort to ensure that the great potential of atomic energy to benefit mankind is realized. (auth)

26365 STUDY OF ^{85}Sr KINETICS IN HYPOPARATHYROID PATIENTS FOLLOWING INGESTION OF DIFFERENT LEVELS OF CALCIUM. Litvak, Jorge; Oberhauser, Ernesto; Armendaris, Renee; Riesco, Jorge; Lopez, Oscar; Alliende, Isabel; Solis, Fresia (Univ. de Chile, Santiago). Rev. Med. Chile, 93: 140-6(Mar. 1965). (In Spanish).

Metabolism of ^{85}Sr was studied in 2 normal subjects and in 3 with hypoparathyroidism secondary to thyroidectomy. Theoretical aspects of radiostrontium metabolism are discussed, and a model is developed for distribution of the isotope in various body compartments. The subjects were maintained on various levels of Ca intake during the experiments. Strontium-85 was administered in doses of 50 μC; (as the chloride) intravenously and its activity in serum at 1, 4, 8, and 12 hr was determined and based on Ca levels. The results showed that the rate of bone accretion and the magnitude of the rapidly exchanging space are reduced in hypoparathyroidism. The biological half time and the serum activity of ^{85}Sr were increased as compared with controls. No correlation was found between the level of Ca intake and the extent of the changes in ^{85}Sr distribution. These results, when considered with urinary excretion rates of hydroxyproline, indicate decreased bone resorption in hypoparathyroid patients. The absence of any change in ^{85}Sr kinetics with changes in Ca intake demonstrates the absence of parathyroid reserve to a significant degree. (BBB)

26366 IMPROVED ERYTHROPOIETIC RECOVERY IN LETHALLY IRRADIATED RATS AFTER TRANSFUSION OF BUFFY COAT CELLS FROM THE BLOOD OF PARTIALLY SHIELDED, HEAVILY IRRADIATED DONORS. Lord, B. I. (Univ. of Washington, Seattle). Nature, 214: 924-5(May 27, 1967).

Some preliminary results are reported showing the advantageous effects of buffy coat cells over normal bone marrow in promoting haemopoietic recovery in lethally irradiated rats. Since such rats show recovery in the bone marrow much earlier and to a considerably greater extent than in the spleen, it was felt that the method used for quantitating recovery should incorporate some measure of cell proliferation in the bone marrow, and it was decided to measure the output of the whole erythropoietic system in terms of the numbers of new erythrocytes (reticulocytes) appearing in the circulation. Results are given for the degree of reticulocytosis following the transfusion of normal bone marrow cells to lethally irradiated rats (forming a baseline for measuring erythropoietic recovery), and for degree of reticulocytosis following the transfusion of buffy coat cells from the blood of irradiated rats to lethally irradiated rats. It was found that buffy coat from partially irradiated animals is very much richer in erythropoietic stem cells than either normal buffy coat or bone marrow. From the preliminary investigation it was not possible to identify the cell type responsible for the recovery, but support was obtained for the suggestion that some part of the monocytoid group of cells is responsible for erythroid recovery. (UK)

26367 EFFECTS OF X-RAY IRRADIATION ON ASCORBIC ACID METABOLISM. Hashimoto, Takaji (Kyoto Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 26: 362-74(July 1966). (In Japanese).

Adult rabbits were exposed to total body x-ray irradiation. Decrease in the ascorbic acid content of the adrenals, liver, spleen and blood was seen. In rabbits irradiated at 1000 R the ascorbic acid was decreased immediately after irradiation; 400 R did not result in an immediate reduction in tissue ascorbic acid, but rather a tendency to increase was noted. The effect of x-ray irradiation on the liver was about the same as above. The ascorbic acid loading test was performed. Decrease in the urinary excretion and high ratio of oxidized ascorbic acid to total ascorbic acid were observed in irradiated rabbits. (NSA of Japan)

26368 STUDY OF THE INTERACTION OF Fe AND Mn, AND THEIR EFFECTS ON THE UPTAKE OF P IN RICE PLANTS BY RADIOISOTOPE TECHNIQUE. Alam, S. Manzoor; Karim, A. Q. M. B.; Khan, A. B.; Habibullah, A. K. M. (Atomic Energy Center, Dacca, Pakistan). pp 82-90 of Proceedings of the Agricultural Symposium. Dacca, Pakistan, Atomic Energy Center, 1966.

Solutions containing various contents and ratios of ^{59}Fe, ^{54}Mn, and ^{32}P were added to rice culture media. Five-week seedlings were then allowed to grow for 2, 4, and 8 days after transplantation. Each treatment was replicated thrice. Plant samples were collected from 3 pots of similar treatment after 2, 4, and 8 days' growth. In dry plant material as obtained earlier, the radioactive Fe and Mn were determined by gamma scintillation counter, while the absorption of ^{32}P was determined by G-M liquid counter. The data were studied to observe the effects of Mn on the uptake of ^{59}Fe, the effects of Fe on the uptake of ^{54}Mn, and the effects of Fe and Mn on the uptake of ^{32}P. It was found that Mn, when applied at increasing rates to culture solutions containing different levels of ^{59}Fe, decreased the uptake of ^{59}Fe progressively except in the case of 5 PPM of Mn where slight increase in the absorption of ^{59}Fe was recorded. Secondly, when Fe at an increasing rate was added to nutrient solutions containing different levels of ^{54}Mn, it was found to reduce the Mn content of the rice plants. (H.L.W.)

26369 INTERACTION OF IRON AND MANGANESE ON THE UPTAKE OF IRON AND YIELD OF RICE PLANTS. Alam, S. Manzoor; Khan, Abdul Baten (Atomic Energy Center, Dacca, Pakistan). pp 95-9 of Proceedings of the Agricultural Symposium. Dacca, Pakistan, Atomic Energy Center, 1966.

Plant samples were collected by cutting after 20 and 40 days and these were weighed after drying in an oven at 70°C. From the dry plant materials the radioactive iron was determined by direct counting in a scintillation counter. From an analysis of the data, it was noticed that manganese, when applied at increasing rates to the nutrient culture solution containing different levels of ^{55}Fe, progressively decreased the uptake of ^{55}Fe. The lowest yield was recorded with a dose of 5 PPM of manganese along the same dose (5PPM) of ^{55}Fe. On the other hand the highest yield was recorded at a dose of 10 PPM of ^{55}Fe in the absence of Mn. As a result of the decrease in the uptake of ^{55}Fe due to increased Mn, the growth of the rice plant was adversely affected. It was further observed that the uptake of radioactive iron by rice plants increased with the increased growth period. (auth)

26370 APPLICATION OF ISOTOPES AND RADIATION IN RICE CULTIVATION FAO/IAEA-PAEC CO-ORDINATED RESEARCH PROGRAMME. Khan, A. B.; Haq, M. S.; Rahman, L.; Habibullah, A. K. M.; Islam, A. H. M. Habibul (Atomic Energy

Center, Dacca, Pakistan). pp 100-11 of Proceedings of the Agricultural Symposium. Dacca, Pakistan, Atomic Energy Center, 1966.

Studies were conducted on the utilization of fertilizer phosphorus by rice plants as affected by different methods of placement, using ^{32}P labeled superphosphate. Other studies were conducted to determine the efficiency of fertilizer nitrogen utilization, applied to low land rice as affected by time and rate of application, and to determine the efficiency of fertilizer phosphorus utilization, applied at transplanting, by time and rate of nitrogen application. ^{15}N and ^{32}P were used as tracers in these studies. (H.L.W.)

26371 SOLID PHASE RADIOIMMUNOASSAY. Catt, K. (Prince Henry's Hospital, Melbourne); Niall, H. D.; Tregear, G. W. Nature, 213: 825-7(Feb. 25, 1967).

It is stated that all forms of radioimmunoassay employed at present include a procedure to separate free and bound tracer antigen when equilibrium is reached in the incubation mixture. This increases the length and complexity of the assay and introduces possible sources of error. A system in which both the antigen-antibody reaction and the above separation could be achieved in a single step would be a valuable innovation. The application of substituted polymers conjugated to the antigen for the isolation of antibody suggested the possibility of using this type of procedure in reverse to achieve this aim. In the presence of antibody coupled to an insoluble polymer, antigen which becomes bound to antibody will be attached simultaneously to a solid supporting medium. If radioactive tracer antigen is present in the system, the solid phase has simply to be washed and counted to determine the degree of antibody binding. The feasibility of the method was tested with a solid phase antibody consisting of diazo-polystyrene coupled to rabbit antiserum, to human growth hormone, and the latter labelled with ^{131}I as tracer antigen. It was found that the binding of the labelled hormone to the solid phase was reduced by the presence of unlabelled hormone over the range 1 to 10 μg. This demonstration of the suitability of the solid phase antibody as the basis of a radioimmunoassay led to extension of the sensitivity of the method to the physiological range. The solid phase support used was the isothiocyanate derivative of a graft copolymer of polytetrafluoroethylene (Fluon G4') and styrene. This was employed for the radioimmunoassay of human growth hormone, coupled to anti-human growth hormone rabbit gamma globulin. Application of the method to estimation of antigen in the subnanogram range should readily be achieved by further reduction in the amount of antibody present in the system, with corresponding increase in the period of incubation and the specific activity of the tracer antigen. Further advantages of the method are described. (UK)

26372 MUTAGENIC EFFECT OF IRRADIATED DNA IN DROSOPHILA MELANOGASTER. Parkash, O. (Univ. of Vienna). Nature, 214: 611-12(May 6, 1967).

Some contradictory results have been reported on this topic. For this reason the present authors repeated their earlier experimental work. The DNA employed was fish sperm DNA, in powder form. Experimental details are given. Male X-chromosomes were examined for the presence of sex-linked recessive lethals. Results were statistically significant, but not so high as in the earlier studies; they indicated that irradiated DNA is mutagenic. Discrepancies between results are discussed. (UK)

26373 COMPLETELY DEUTERATED PROTEINS. III. DEUTERATION EFFECTS ON PROTEIN-PROTEIN INTERACTION IN PHYCOCYANIN. Scott, Edith; Berns, Donald S. (New York State Dept. of Health, Albany. Albany Medical Coll.). Biochemistry, 6: 1327-34(May 1967).

The state of aggregation of fully deuterated phycocyanin was studied as a function of pH, temperature, and ionic strength by sedimentation velocity measurements. Studies of the pH dependence of viscosity and absorption spectra are also presented. The data are compared to those for the normal phycocyanin. Under comparable conditions the deuterio protein contained less 11S material and very little 19S material and an enhanced amount of 7S and 3S species. Possible explanations for the results included conventional isotope effects, hydrophobic bonding, and van der Waal's interaction. It is suggested that the 11S aggregate was normally stabilized by dispersion forces in combination with hydrophobic and other forces competing with electrostatic repulsion between the identical subunits, and that in the deuterated protein there was a decrease in polarizability of the groups involved in the protein-to-protein interaction. More efficient competition of the electrostatic repulsion resulted in a decreased stability of 11S species with the appearance of more 7S material. (auth)

26374 INCREASE IN POTASSIUM CONTENT IN HUMANS MEASURED WITH THE WHOLE-BODY COUNTER. **Oberhausen, E. (Univ., Saarlandes, Ger.). Ann. Paediat., 205: 381-400(1965). (In German).**

The construction, mode of operation, and calibration of a whole-body counter are described. When liquid scintillators are used, the larger bandwith make it difficult to separate energies that are found in persons who work with radioisotopes. If only ^{40}K and ^{137}Cs are present, as in normal individuals, these can be detected separately with a liquid scintillator. Use of large liquid scintillators compensates for their lower energy resolution capability. Only two min are required for measurements, as compared to 15 to 30 min for NaI crystals. The fluid volume of the scintillator described amounts to 280 l, arranged in a semicircular cylinder. The shielding consists of Pb with wall thickness of 7.5 cm, reducing radiation by a factor of ~50. Calibration of the whole-body counter was made by measurements of containers of KCl, with over-all linear measurements calculated to conform to various body wt and sizes. The sensitivity of the detector was greater at the central portion, and fell off sharply at the ends. The two most important parameters for calibration were the average dia and the body height. A comparison between K estimation using ^{42}K and calibration with a plastic phantom showed deviations that ranged from −10.5 to +7.9%. (BBB)

26375 INFLUENCE OF WHOLE-BODY GAMMA-IRRADIATION ON NUCLEAR HISTONES IN RAT SPLEEN AND LIVER. **Suhar, Alojz; Furlan, Miha (Nuclear Inst. Jozef Stefan, Ljubljana, Yugoslavia). Strahlentherapie, 132: 604-9(Apr. 1967).**

Nuclear histones from rat spleen and liver were fractionated on carboxymethylcellulose column into lysine-rich fraction f1, slightly lysine-rich fraction f2, and arginine-rich fraction f3. The changes in the concentration of the three histone fractions were measured 3 and 24 hours after whole-body gamma-irradiation of rats with 600 R. A pronounced decrease in the contents of f1 and f2 was observed in the spleen after 24 hours, whereas the concentration of the f3 histone calculated per gm tissue weight was increased. No significant alterations in the distribution of histones were noticed in the liver nuclei of the irradiated rats. The possible explanations of the observed changes are discussed. (auth)

26376 THE INFLUENCE OF DIETS WITH A VARYING UNSATURATED FATTY ACID CONTENT ON NUCLEIC ACID METABOLISM IN RAT SPLEEN EXPOSED TO X-RAY RADIATION. **Nemec, Rudolf; Ginter, Emil; Laginova, Viera (Inst. of Human Nutrition Research, Bratislava). Strahlentherapie, 132: 610-17 (Apr. 1967).**

The influence of four kinds of synthetic isocaloric diets, having a differing content of unsaturated fatty acids, on ^{32}P incorporation into ribonucleic and deoxyribonucleic acid in the spleen of white Wistar rats was studied. The rats were irradiated with a single dose of 600 R. At 24 hours after irradiation there was a decrease in ^{32}P incorporation into RNA and DNA in all the group of animals. At 48 hours a normalizing tendency was observed, while at 96 hours after irradiation the conditions became normalized in the process under investigation. The most marked deviations from the normal occurred in animals fed on a diet with a high unsaturated fatty acid content (linseed oil), while the deviations were the slightest in the case of rats fed on a diet with a low unsaturated fatty acid content (coconut oil). The results appear to indicate that in prophylactic diets used against radiation sickness it is more advantageous to employ fats having a lower content of unsaturated fatty acids. The results of the present study do not refute the protective role played by the essential fatty acids. The need for quantitative studies in this sphere is also stressed in the study. (auth)

26377 DETOXIFICATION OF SALMONELLA TYPHIMURIUM LIPOPOLYSACCHARIDE BY IONIZING RADIATION. **Previte, Joseph J.; Chang, Y.; El-Bisi, H. M. (U. S. Army Natick Labs., Mass.). J. Bacteriol., 93: 1607-14(May 1967).**

The efficiency of ionizing radiation in detoxifying the lethal determinant(s) of the lipopolysaccharide (LPS) of Salmonella typhimurium, S. enteritidis, and Escherichia coli in aqueous solution and associated with heat-killed S. typhimurium cells in suspension decreased with doses above 1 Mrad. The 50% end point of inactivation was more than 7.0 Mrad for heat-killed salmonellae and 4.8, 4.5, and 1.0 Mrad for the LPS of S. typhimurium, S. enteritidis, and E. coli, respectively. After exposure to 20 Mrad, S. typhimurium LPS retained a small portion of its lethal properties although the LD_{50} was much greater than 9.5 mg per 20-g mouse. However, at −184 C, no inactivation of the lethal determinant(s) occurred after exposure to as much as 20 Mrad. This demonstrated the significance of the indirect effect and the mobility and formation of free radicals. At 22 C, the optical density at 400 mμ increased and the pH decreased with increasing radiation dose, but no qualitative changes were observed in the infrared spectrum. No change was observed in the pyrogenicity of S. typhimurium LPS; a slight decrease in antigenicity was revealed when 6 days, but not when 1 day, elapsed between vaccination and challenge in the mouse protection test. The results were interpreted as evidence of the existence of two or more lethal and antigenic determinants. The differential effect of radiation on these properties and on the pyrogenic component(s) probably are indicative of separate functional sites for lethal, antigenic, and pyrogenic activities. (auth)

26378 EFFECTS OF FERTILIZATION ON THE STRONTIUM–CALCIUM AND CESIUM–POTASSIUM RELATIONSHIPS IN PLANTS. II. THE UPTAKE AND DISTRIBUTION OF RADIOACTIVE CESIUM AND POTASSIUM IN OATS. **Andersen, A. J.; Gissel-Nielsen, G. (Danish Atomic Energy Commission Research Establishment, Risoe). Kgl. Vet.-Land. Bohoejsk., Arsskr., 168-78(1967).**

The effects of carrier cesium and Mg, K and N fertilization were measured in pot experiments. Addition of 5 and 50 mg stable Cs per pot (21 kg soil) increased the ^{137}Cs uptake by oats appreciably. The uptake and distribution of ^{42}K and ^{137}Cs in the plants were only slightly affected by adding $MgSO_4 \cdot 7H_2O$, while N supplied as $(NH_4)_2SO_4$ increased the ^{137}Cs concentration both in grain and straw. The effect of K supply was an increased ^{42}K uptake and generally a decreased ^{137}Cs uptake, depending on the yield of dry matter. The data did not show any interaction between K and Cs in respect to their distribution in grain and straw. (auth)

26379 EFFECTS OF FERTILIZATION ON THE STRONTIUM–CALCIUM AND CESIUM–POTASSIUM RELATIONSHIPS IN PLANTS. I. THE UPTAKE AND DISTRIBUTION OF RADIOACTIVE STRONTIUM AND CALCIUM IN OATS. **Andersen, A. J.; Gissel-Nielsen, G.; Nielsen, G. (Danish Atomic Energy Commission Research Establishment, Risoe). Kgl. Vet.-Land. Bohoejsk., Arsskr., 154-67(1967).**

The effects of Mg, K and N fertilization were measured in pot experiments. Increasing amounts of $MgSO_4$, $7H_2O$ reduced the ^{45}Ca uptake more than the ^{89}Sr uptake by oats grown on a coarse sandy soil. The ratio ^{89}Sr/^{45}Ca in the straw increased, but in the grain this ratio was not changed by variations in Mg supply. The effects of K varied between the soils and with the nutrient content in the soils. The ^{89}Sr uptake from all the soils was reduced by adding K, and the ^{45}Ca uptake was reduced from two loamy soils but not from the calcium-poor coarse sand. Both the ^{90}Sr and ^{45}Ca uptake were appreciably increased by adding increasing amounts of $(NH_4)_2SO_4$, but the two ions were not equally affected. The ratio ^{90}Sr/^{45}Ca was decreased in both grain and straw by N application, but the decrease was most pronounced in the grain, which indicate an increased discrimination against ^{90}Sr relative to Ca in the translocation of the two ions from straw to grain. (auth)

26380 EFFECT OF ULTRAVIOLET LIGHT ON RIBONUCLEASE. **Mueller, H. G. (Institut fuer Biophysik, Berlin). Biol. Rundsch., 4: 100-2(1966). (In German).**

The effects of uv light from a Hg lamp with its principal band located at 2537 Å on the activity of purified ribonuclease on RNA at pH 5 were measured. At a substrate concentration of 2 mg/ml an irradiation of more than 10^7 erg/cm^2 was required before any effect on enzymatic activity was observed. The course of inactivation was exponential, and was characterized by a D_{37} of 9.2×10^7 erg/cm^2. Subsequent heating increased the loss of activity. The quantum factor for this wavelength has been shown to be 0.027. Column chromatography analyses of acid hydrolyzates of the enzyme gave no significant indication of damage to particular amino acid residues, except for a slight decrease in glutamic acid, methionine, and tyrosine. Because of losses during hydrolysis or incomplete hydrolytic release, values for threonine, serine, isoleucine, and tyrosine were considerably decreased, and cysteine was not detectable. Because the aromatic and S-containing amino acids are known to be relatively radiosensitive as compared to the aliphatic amino acids, this may account for the decreased tyrosine observed. Chromatography of the unhydrolyzed irradiated ribonuclease indicated only one peak, located in the same position as native ribonuclease A, but with decreased activity as compared to the latter. (BBB)

26381 UPTAKE OF CESIUM AND ITS DISTRIBUTION IN THE PLANT. **Marschner, H. (Landwirtschaftliche Hochschule, Stuttgart-Hohenheim, Ger.). Z. Pflanzenernaehr. Dueng. Bodenk., 95: 130-42(1961). (In German).**

The uptake and distribution of ^{134}Cs were studied in experiments of 12 hr duration in barley plants and in pot experiments with sand using mustard plants. Special interest was taken in changes in Cs in relation to K content. At a constant Cs concentration of 1 meq/l, increasing addition of K from 2.5 to 30 meq/l reduced the Cs content in the roots as well as in the shoots, i.e., the translocation from the external solution into the shoots is mainly an active process. At high K concentrations in the pot experiments the distribution factor (V_t) = (Cs/K plant)/(Cs/K solution) in the shoot was 0.8. If the transpiration intensity was reduced to $^1/_{10}$ of its normal value the uptake of K was not affected but the uptake of Cs was reduced markedly. Therefore, the V_f value decreased to 0.5 – 0.7. Within the different parts of the shoot there were marked differences in the Cs/K ratio. The V_f value in the stems and petioles was about 0.3 and in the leaf blades > 1. Higher leaves had increased V_f values. In the youngest leaves and in the flowers the V_f value was 1.8 to 2. The reutilization of K in the plant took place to a greater degree than that of Cs. If the supply in the external solution was insufficient, K was translocated from the older leaves and stems to the younger parts in a greater degree than Cs; therefore, the original V_f value was increased in this older parts but decreased below 1 in the younger parts. (BBB)

26382 THE ROLE OF THYMINE DIMER IN THE PHOTOINACTIVATION OF THE BACTERIOPHAGE T4v_1. Wulff, Daniel L. (Univ. of California, Irvine). J. Mol. Biol., 7: 431-41(1963).

Experiments were conducted to test the earlier claim that thymine dimer formation should not occur upon low-dose uv irradiation, but only after the formation of certain other photoproducts in the DNA which presumably soften up its secondary structure. To resolve this question, thymine dimer formation was compared to uv inactivation in one and the same population of the bacteriophage T4v_1 and in the same dose range. T4v_1 has a uv sensitivity like T2, apparently because it lacks the ability to form an enzyme to repair uv damage. When thymine dimer formation and uv inactivation at 260 mμ were compared, an average of 4.8 thymine dimer molecules was found in a phage per phage lethal hit. Thus most thymine dimer molecules have no effect whatsoever upon plaque-forming ability. Comparison of formation rates showed that most thymine dimer molecules cannot be interstrand crosslinks. The rate of thymine dimerization was linear from the lowest uv doses up to about 2000 erg/mm^2, after which it decreased. Thymine dimer is probably formed between adjacent thymine molecules on the same strand of DNA. (BBB)

26383 ENAMEL DECALCIFICATION BY CEREALS OF DIFFERENT GEOGRAPHIC ORIGIN. **Khanna, Shadi L.; Bibby, Basil G. (Univ. of Manitoba Dental School, Winnipeg). J. Dent. Res., 45: 927-33(May-June 1966).**

A neutron activation method was used to produce radioactive enamel for demonstrating that different quantities of enamel are dissolved by the salivary fermentation products of lots of wheat germ milled at different locations. The comparisons of enamel dissolution were made by subjecting 20- to 40-mesh radioactive ox enamel to filtrates of salivary fermentations of the cereals. The enamel was made radioactive by 1-hr exposure to a neutron flux of 10^{13} neutron/cm^2/sec at a temperature below 40°C. Granular enamel was used because, although neutron bombardment reduced enamel solubility, the particulate enamel gave more consistently reproducible results than when blocks were used. Enamel decalcification was determined by exposing 50 mg of the granular radioactive enamel of 5 ml of a cereal filtrate for 2 hr at 37°C. After filtration, 1-ml. filtrate aliquots were dried and radioactivity was measured using a gas glow counter. Wheat, corn, oat, and barley grain, and several of their milling products from 4 states and 2 Canadian provinces, were tested for solubilizing effects on the radioactive enamel. Cereal samples from some areas dissolved several times more enamel than fractions from other areas, but no constant geographic pattern of differences was discernible. (BBB)

26384 RADIATION EFFECTS ON POLYNUCLEOTIDES. **Logan, David MacKenzie. Toronto, Univ. of Toronto, 1965. Thesis.**

The effects of ultraviolet light (UV) on the synthetic polynucleotide, Polyuridylic acid (Poly U) is reported. Ultraviolet irradiation of Poly U caused the production of two major photoproducts, hydrates and dimers. The former arose from the addition of a water molecule across the previously unsaturated 5,6 double bond of the uracil base and the latter were formed by the joining of two uracil bases at their 5,6 positions to give two hexagonal rings joined by a cyclo butane ring. Poly U is biologically active in an in vitro protein synthesizing system where it directs the synthesis of poly L-phenylalanine. The steps in this reaction are thought to be: first the complexing of the messenger Poly U with ribosomes to form an active template, second the attachment of phenylalanyl-SRNA to this template (recognition is by complementary triplets UUU in the Poly U and AAA in the SRNA), third the joining of the phenylalanine molecules by at least 2 enzyme reactions and finally the release of the polypeptide. Grossman studied the loss of phenylalanine incorporation when Poly U was irradiated at one wavelength (254 mμ) and subsequently suggested that dimers in the Poly U do not code whereas hydrates may miscode and in some cases at least act as cytidylic acid residues in the polynucleotide. The loss of phenylalanine incorporation by irradiating Poly U at different wavelengths from 240 to 289 mμ was investigated. Different photoproducts were formed preferentially in Poly U at different wavelengths in this region and a study of the photoproducts that did not code or miscoded in the in vitro system was made. The data indicated that in the in vitro system successive runs of UUU triplets in the Poly U unnecessary for phenylalanine incorporation and possibly only one or two unaffected uracil residues were required to direct the incorporation of a phenylalanine molecule. The sensitivity of the UV induced loss of phenylalanine incorporation was measured and compared with the known sensitivities of the reactions in which hydrates and dimers were formed. In addition Monte Carlo calculations were performed on the loss of unaffected uracil residues when Poly U was irradiated. Both these calculations suggested that neither dimers nor hydrates code in the in vitro system. Two other characteristics of the irradiated Poly U in the in vitro system were also investigated. The first of these was the stability of the Poly U. Unirradiated Poly U was degraded rapidly in the in vitro system. UV irradiation of the Poly U decreased its sensitivity to the degradative nucleases and when approximately 60% of the uracil bases were converted to photoproducts the Poly U was completely insensitive to degradation. The impairment of other enzymes acting on the Poly U, by irradiation of the Poly U, was also suggested by the decrease in the rate as well as the level of phenylalanine incorporation when the Poly U was irradiated. The second characteristic of the irradiated Poly U that was investigated was its ability to complex with ribosomes. This was investigated by sucrose density gradient centrifugation. The complexing of ^{14}C-labelled Poly U with ribosomes, and ribosomal subunits was studied. At 8°C unirradiated Poly U bound well to ribosomes but not to ribosomal sub-units. When Poly U was irradiated there was no change of binding to ribosomes until 40-50% of the bases were converted to photoproducts. With further irradiation there was decreased binding and large doses (>90% of the bases converted) effectively eliminated all binding. Intermediate doses of UV to the Poly U increased the binding to ribosomal sub-units by large amounts. The studies on the stability and binding of Poly U suggested that the loss of phenylalanine incorporation with UV radiation may be explained by changes in both coding and complex formation. The dehydration of UV-irradiated Poly U and its subunits was also studied. The hydrated photoproducts of uridine and its derivatives dehydrate spontaneously and the rate was increased at either high or low pH and high temperature. The effect of the nucleotide phosphate on the dehydration was indicated by the decreasing rates of dehydration for Ur, Up(2′), pU, Up(3′) and pUp respectively. The dehydration curve of UpU consisted of two components with rates characteristic of 3′ and 5′ linked mononucleotides, Oligo- and polynucleotides dehydrated with rates inversely related to their chain length. The pH dependence of the dehydration reaction was measured and the resulting curve was very similar to the titration curve of the uracil ring. This suggested that the dehydration rate depended on the charge on the uracil ring. The dehydration reaction for all compounds tested had an activation energy of 17.7 K Cal/mole. (Dissertation Abstr.)

26385 REACTIONS OF HYDROGEN ATOMS AND HYDROXYL FREE RADICALS WITH NUCLEIC ACIDS, NUCLEIC ACID CONSTITUENTS, AND CONSTITUENT ANALOGS: AN ELECTRON SPIN RESONANCE STUDY. **Holmes, Donald Eugene.** Los Angeles, Univ. of California, 1966. 138p.

Thesis.

The absorption of radiation in matter produces free radicals. A study of the effects of radiation produced free radicals on the constituent parts of living matter may yield specific information on the mechanism of the biological effect of radiation. Therefore, an electron spin resonance study has been made of the reactions of hydrogen and hydroxyl free radicals with nucleic acids, nucleic acid constituents, and related analogs; time dependent changes in radical structure and yields were observed. Hydrogen atoms were produced in an electrodeless discharge and flowed through a lypholyzed sample that had been dispersed in quartz wool. Hydroxyl free radicals were produced by photolyzing a frozen mixture of hydrogen peroxide and the sample material. Pyrimidines with an unsaturated 5,6-double bond add radicals at that position while abstraction takes place if the position is saturated. Radicals add to purines at the 7,8-double bond. Nucleosides, nucleotides, polynucleotides, and nucleic acids initially undergo addition reactions, but apparent abstraction from the sugar moiety finally predominates with ribose and deoxyribose giving similar spectra. (Dissertation Abstr.)

26386 DENATURATION OF ENZYMES BY THE DIRECT ACTION OF IONIZING RADIATION AND ENZYMICALLY ACTIVE COMPONENTS OF THE CRYSTALLINE CHYMOTRYPSINS. Henderson, Louis Edwin. Boulder, Colo., Univ. of Colorado, 1966. 83p.

Thesis.

The inactivation of alpha-chymotrypsin by the direct action of gamma radiation was shown to be an all-or-none process. The enzymic specific activity and the operational active sites of the enzyme were lost with the same D_{37} dose. No chemically altered but enzymically active molecules produced by irradiation could be detected by ion exchange chromatography or gel electrophoresis. The direct action of gamma radiation on alpha-chymotrypsin results in sufficient alterations of the ordered conformation of the molecule to account for loss of enzymic activity. The hard to exchange amide hydrogens (HEAH) of irradiated alpha-chymotrypsin are lost by a multi-hit process. The protein irradiated to 50% inactivation showed no change in the amino acid analysis or disulfide analysis. There was no evidence for specific chemical changes produced by radiation in the electrophoretic patterns of the reduced and non-reduced protein. The doses required to inactivate a molecule of chymotrypsinogen, delta-chymotrypsin, and papain are also reported. These doses do not differ significantly from the dose required to inactivate alpha-chymotrypsin. An ion exchange column is described which is capable of resolving the crystalline chymotrypsins into their respective components. Each crystalline chymotrypsin contains contamination of the other chymotrypsins. 3X crystallized alpha-chymotrypsin contains about 16% beta or gamma-chymotrypsin. "Disc" gel electrophoresis of fluorodiisopropyl phosphate ^{32}P-labeled chymotrypsins in 8M urea reveals a different electrophoretic mobility for alpha, beta, and gamma-chymotrypsin. However, these proteins all yield the same electrophoretic pattern following reduction with thioethanol. This suggests that these proteins may differ only in their disulfide arrangement. (Dissertation Abstract)

Ecology

Refer also to abstracts 26233 and 26408.

26387 (COO-1445-5) RADIOECOLOGY OF THE COLORADO FRONT RANGE. Terminal Report. Osburn, W. S. Jr. (Colorado State Univ., Fort Collins. Dept. of Radiology and Radiation Biology). [1967]. Contract AT(11-1)-1445. 60p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Snowfields in the alpine tundra of the Front Range in Colorado have been reported to concentrate nuclear fallout to relatively high amounts. Upon melting, the nuclear debris released from the snowfield becomes concentrated within several of the associated plant communities and is taken up by animals and birds inhabiting the area. Some sites in this area also have a relatively high level of natural background radiation. Data are presented from a series of ecological studies conducted in this area. Data are presented on the effects of natural background γ radiation at doses of 0.05 to 0.40 R on the morphology of flowering stalks of Penstemon virens in 5 different habitats; the effects of various levels of gross β and γ activity (estimated at 2 to 3 R yr) from fallout on the morphology of Primula parryi (primrose) plants growing in 4 sites characterized by late lying snowfields; the retention of radioactive fallout by several alpine vegetation types over a 3-yr period; measurements of the gross β radiation dose of several species of small mammals trapped from 5 different plant communities in the alpine watershed; and a study of patterns of radioactive fallout distribution by bird populations of a high mountain watershed. Data are included on the gross β radioactivity and content of ^{90}Sr, ^{137}Cs, ^{144}Ce, ^{125}Sb, ^{106}Ru, and ^{54}Mn, from fission products concentrated on the feathers and skin and in the digestive tract of bird species commonly frequenting the alpine and subalpine regions of the Colorado high mountain watershed. (C.H.)

26388 (COO-1486-3) TECHNIQUE FOR CONTINUOUSLY LOCATING SMALL MAMMALS IN FIELD ENCLOSURES. **Graham, W. J. (Michigan Univ., Ann Arbor. Lab. of Vertebrate Biology). June 13, 1966. Contract AT(11-1)-1486. 10p. (CONF-660652-1). Dep.**

From Meeting of American Society of Mammalogists, Long Beach, Calif.

A technique is described for determining periods of daily activity of the meadow vole, Microtus pennsylvanicus. An automated recording device for periodically locating a radioactively tagged vole in a 30 ft. diameter enclosure is described. The voles are tagged with ^{182}Ta which is injected subcutaneously. The amount of radiation from the animal is recorded at the edge of the enclosure, under the probe, and near the base of the instrument for several revolutions to determine radiation intensities at known distances in the enclosure. (H.L.W.)

26389 (RT/BIO-(67)1) BREVI CENNI DI ECOLOGIA. CONCETTI, TERMINOLOGIA E NOZIONI ELEMENTARI. **(Brief Note on Ecology: Principles, Terminology, and Fundamental Ideas). Cigna Rossi, L. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1967. 98p. (In Italian).**

In the present paper are exposed the fundamental ideas and principles of ecology together with the definitions of current terminology. Here are also briefly described the fresh-water, marine and terrestrial habitats, and their most important features and subdivisions. The relations between ecology and radioactivity are outlined, under their fundamental points of view: radioecology (radiation ecology) and study of the "ecocycles" of radionuclides. (auth)

26390 CERTAIN PATTERNS IN THE BEHAVIOR OF ALKALINE EARTH ELEMENTS (Ca, Mg, Sr) IN FOREST BIOGEOCENOSIS. **Aleksakhin, R. M.; Ravikovich, M. M. Soviet Soil Sci. (Engl. Transl.), No. 4, 414-21(Apr. 1966).**

The distribution of Ca, Mg, and Sr at various stages of biogeocenosis was studied in a birch forest. The litter, soil, and vegetation were sampled in 1962 and 1964. Some correlations were noted for the presence of Ca, Mg, and Sr in the soil profile, as well as individual differences in the comparative distribution of these elements and their exchangeable forms in the various genetic strata. The Ca and Sr distribution (but not that of Mg) in the woody vegetation had an acropetal character; the content of these elements was generally higher in the lower parts of plants than in the upper parts. The values of so-called observed ratios during Ca and Sr migration in various chains of the soil-birch phytocenosis system varied between 0.4 and 3.2 (0.5 to 1.5 for most chains). These values amounted to 0.3 to 12.5 for the Sr–Mg pair. It is suggested that data on the migration patterns in the soil–plant system of stable Sr, that is normally present in the soils, are valid only if certain limitations in determining a plant's accumulation of radiostrontium entering through the root system are accepted. (BBB)

26391 NATURAL RADIONUCLIDES IN FOODS AND FOOD SOURCE MATERIALS. **Klement, Alfred W. Jr. (Atomic Energy Commission, Washington, D. C.). pp 113-55 of Radioactive Fallout, Soils, Plants, Foods, Man. Fowler, Eric B. (ed.). Amsterdam, Elsevier, 1965.**

This review, with 212 references, considers the occurrence of natural radioisotopes in the biosphere. Numerous tables of data are given: physical properties of primordial radionuclides, decay schemes of the U, Th, and Ac series, cosmic-ray activated radionuclides, soil and water levels of nuclides, and Ra content of dietary items in different localities. Much information is available with respect to some nuclides of the U, Th, and Ac series and ^{40}K, ^{14}C, and ^{3}H. Less data of interest here are available for ^{87}Rb. Inferences are made, with caution, for the occurrence of the radioisotopes of lead, including ^{204}Pb. Few data are available for other natural radionuclides. Much data has been reported for concentrations of natural radionuclides in agricultural and other biological materials which form parts of the food web. Reference is made to several recent investigations into the dietary intake of a few nuclides, especially ^{226}Ra. (BBB)

Genetics and Cytogenetics

Refer also to abstracts 26372, 26619, 26662, and 26677.

26392 VARIATION IN QUANTITATIVE CHARACTERS OF X_2 PLANT AFTER HYBRIDIZATION AND IRRADIATION IN RICE. Miah, Abdul Jalil; Yamaguchi, Hikoyuki (Tokyo Univ.). Jap. J. Breed., 15: 91-6(1965).

Hybrid seeds obtained from a cross between two varieties of rice, Kinmaze and Sasashigure, were stored in a dessicator and treated with γ rays from a ^{60}Co source. Moisture content of the seeds was ~14%. Irradiated seeds were planted in a nursery and after one month, the seedlings were transplanted to a field. Four early appearing ears were harvested from each X_1 plant and analyzed for ear fertility. From each X_1 ear, 5 grains were removed and bulked to grow X_2 generation plants. One ear from individual X_2 plants was harvested and data were recorded on grain size and endosperm quality. Data for the characters studied in X_2 generations were analyzed by approximate analysis of variance. In all cases, the mean value of γ-irradiated populations increased. Endosperm quality of irradiated populations showed an increase in mean value and variance. Results obtained suggested that background genotype played an important role in the manifestation of mutated characters. (B.H.S.)

26393 MUTAGENESIS IN ESCHERICHIA COLI BY VISIBLE LIGHT. Webb, Robert B.; Malina, Mylan M. (Argonne National Lab., Ill.). Science, 156: 1104-5(May 26, 1967).

Mutation to resistance to bacteriophage T5 in continuous cultures of Escherichia coli was induced by visible light (wavelength longer than 408 nanometers) and by black light (300 to 400 nanometers). Mutation rates more than 18 times greater than the spontaneous rate (no light) were obtained with moderate, nonlethal intensities of visible light. Mutation rates for both visible and black light were proportional to irradiance. (auth)

26394 MINIATURE CENTRIC FRAGMENT CHROMOSOMES IN MUTAGEN-TREATED PEARL MILLET, PENNISETUM TYPHOIDES. **Powell, Jerrell B.; Burton, Glenn W. (Univ. of Georgia, Tifton). Crop Sci., 6: 590-3(Nov.-Dec. 1966).**

A miniature centric-fragment chromosome was observed in pearl millet, Pennisetum typhoides, subjected to thermal neutron and ethyl methanesulfonate treatments. The very small chromatic particles oriented themselves at the metaphase I plate, and divided and moved to the poles at anaphase I, but were irregular in their behavior at anaphase II. Most plants with these centric-fragment chromosomes were found in the thermal neutron treatments, with some in the ethyl methane sulfonate treatments, but none in the controls. One miniature centric-fragment chromosome was the most common number present in microsporocytes of single plants, with the exception of one plant which contained two fragment chromosomes per cell. Size variation in the particles was noted in one plant. These miniature centric-fragment chromosomes, discovered in mutagen-treated pearl millet, may have an origin similar to the small ring chromosomes described in maize. (auth)

26395 POSTRADIATIONAL EFFECT OBSERVED DURING SEED-STORAGE, AS DEPENDENT ON THE DOSE AND INTENSITY OF IRRADIATION. Filev, K. A. (Central Lab. of Genetics, Sofia). Dokl. Akad. Nauk SSSR, 169: 680-2(July 21, 1966). (In Russian).

The dose-dependency of yield of radioinduced chromosome aberrations was studied in seeds of barley (Hordeum vulgare L.) exposed to 1, 5, or 10 kR of ^{60}Co γ rays. Application of least squares showed that aberrations increased linearly with dose in seeds examined after 1, 15, 30, and 60 days of storage. (R.V.J.)

26396 INDUCED MALE STERILITY IN JUTE (CORCHORUS CAPSULARIS L.). Rakshit, S. C. (Univ. of Kalyani, India). Idengaku Zasshi, 42: 139-43(Apr. 1967).

A slow growing male sterile mutant, Ribbon, was first observed in the M_2 progenies of dry seeds of Corchorus capsularis L treated with 70,000 R. Genetically, normal leaf trait was found to be dominant over Ribbon trait and male fertility over sterility. The leaf variation is controlled by one factor pair and is similar to the case with male sterility. The trend of fluctuation of pollen sterility in F_2 population indicates the probability of the presence of two closely linked genes controlling the two traits. (auth)

26397 THE EFFECTS OF X-RAY IRRADIATION ON SELECTION RESPONSE IN DROSOPHILA MELANOGASTER. Kitagawa, Osamu (Tokyo Metropolitan Univ.). Idengaku Zasshi, 42: 121-37(Apr. 1967).

Experiments were conducted with Drosophila melanogaster for the purpose of investigating the mechanism by which new genetic variability available for artificial selection is induced by x rays and to estimate the increase in polygenic variability in abdominal bristle numbers. Genetic variability, probably originating from mutation and recombination in polygenic systems, was induced by x irradiation (1500 R) and contributed to the effectiveness of artificial selection. Selection response based on analysis of variance was greatest when both sexes were treated and in groups where males only were treated. Rates of radioinduced mutations, in terms of increments of variance, were 28.1×10^{-5} for both sexes treated, 10.7×10^{-5} for only females treated, and 20.3×10^{-5} for only males treated. (H.G.D.)

26398 CHROMOSOME STRUCTURE AS SEEN WITH TAGGED IRRADIATION. **Mitrofanov, Yu. A. (Inst. of Biological Physics, Moscow). Byull. Eksp. Biol. Med., 63: 96-100(Apr. 1967). (In Russian).**

The structure and evolution of a chromosome during the mitotic cycle depends on the frequency of appearance and transformation types of chromosomes in the mitoses of the irradiated cells. The greatest number of anaphases with aberrations in the first mitosis is seen in cells irradiated in the middle G_2, lesser number among the cells irradiated in the later G_2. Radiosensitivity of cells in later G_2 is relatively small. Cells irradiated in S are relatively radiosensitive; they show aberrations of the chromoid type. Cells irradiated in G_1 are relatively radioresistant, they show aberrations of chromatid and chromosome types. Changes of one type of aberrations by others are explained by changes of chromosome structure in G_1, S, G_2 phases of cell cycles. It was found that cells irradiated in the S phase, possess "sustained mutability"—they show chromosome aberrations (including chromatid aberrations) not only in the first (X_1), but in the second (X_2) and apparently in the third (X_3) mitosis after irradiation. We believe that aberrations of chromosomes in X_2 and X_3 may be due to existence of intrachromosome fine disorders of chromosomes (lesions appearing at the subchromosomal level). Appearance of such lesions in cells, irradiated in phase S, can be apparently explained by the fact that in the phase of chromosome synthesis (phase S) chemical agents (such as peroxides, antimetabolites, radicals, etc., which form in the cell during irradiation) may react very actively with the hereditary structures. Chromosome lesion caused by them, can primarily exist at the molecular (subchromosome) level. Later they can appear as chromosome aberrations. (auth)

26399 X-RAY INDUCTION OF AUTOSOMAL TRANSLOCATIONS IN MATURE OOCYTES OF DROSOPHILA MELANOGASTER. Traut, H. (Univ. of Muenster, Ger.). Nature, 214: 718-19(May 13, 1967).

It appears to be well established that even at high doses x rays induce practically no translocations in the oocytes, although they produce detachments of the X-chromosome. In studies so far only relatively high doses have been used, a procedure which appears promising at first sight, since translocations are ordinarily produced by two hits. If, however, only immature oocytes are resistant to the induction of translocations, low rather than high doses should be chosen. In the studies described the relatively low dose of 500 R was employed, and it was demonstrated that such a dose does induce a relatively high frequency of autosomal translocations in mature oocytes. Results are compared with those for mature sperm. (UK)

26400 EFFECTS OF X-RAYS ON RESPONSE TO SELECTION FOR A QUANTITATIVE CHARACTER OF DROSOPHILA MELANOGASTER. Jones, L. P. (Univ. of Sydney). Genet. Res., 9: 221-31(Apr. 1967).

Drosophila lines with ten pairs of parents and selected at an intensity of 20% were exposed to 1000 R of x rays for 0, 2, 10, or 30 generations. Lines that received some irradiation generally gave greater response than the unirradiated controls. The phenotypic variance in the irradiated lines was much higher than in the controls. There was little difference in behaviour between lines receiving ten generations of irradiation and those irradiated every generation. Lines receiving only two generations of irradiation had lower variances than the other irradiated lines, but in one of three replicates the response was greater than the corresponding continuously irradiated line. Lethal frequencies were much higher in irradiated than unirradiated lines. Particular chromosome II and III lethals were at high frequencies in most of the irradiated lines but in only two out of five controls. On relaxation, the mean of the irradiated lines generally declined considerably, but in the unirradiated lines there was only a very small regression. It appears that most of the extra response and increased variance in the irradiated lines were caused by a few genes with large effect on bristle number. (auth)

26401 DEOXYRIBONUCLEOTIDE SYNTHESIS AND CHROMOSOME BREAKAGE. Kihlman, B. A. (Uppsala Univ.). pp 108-17 of Chromosomes Today. Vol. 1. Darlington, C. D.; Lewis, K. R. (eds.). Edinburgh, Oliver and Boyd, 1966.

The effects of radiation and various types of chemical agents on DNA formation and chromosome aberrations are compared. Point mutations apparently arise as a result of a change in the DNA component of chromosome. Whether structural chromosome changes are the result of breakage or changes in DNA molecules is also discussed. Some evidence indicated that protein synthesis was required for repair of x-ray-induced chromosome damage, and that free radical production by ionizing radiation was greater in protein than in DNA. These findings indicated that protein, rather than DNA, was involved in chromosome breakage. On the other hand, results of studies on the chromosome-breaking effects of chemicals suggested that DNA was the chromosomal component involved. However, structural changes were induced by a large variety of compounds that chemically seem to have in common only their ability to affect the synthesis, state, or structure of DNA. Convincing evidence for DNA involvement in chromosome breakage was the observation that a specific type of chromosomal aberration was produced by certain inhibitors of the synthesis of deoxyribonucleotides, including 5-fluorodeoxyuridine (FUdR), deoxyadenosine (AdR), cytosine arabinoside (CA), and aminopterin. Thus, a characteristic pattern of aberrations was produced when root tip cells of Vicia faba and mammalian cells in tissue culture were treated in late interphase with these agents. The aberrations consisted of gaps, chromatid breaks, and isochromatid breaks without sister union; there were few or no aberrations that involved rejoining of breaks (exchanges, sister union in isochromatid breaks). The rate of DNA and RNA synthesis was determined by measuring the incorporation of ^{32}P into DNA and RNA fractions. In bean root tips complete suppression of DNA synthesis was obtained by concentrations of AdR and FUdR which had no measurable effect on RNA synthesis. Incorporation of ^{32}P into the DNA and RNA fractions of bean root tips was not affected by CA. The FUdR inhibition of ^{32}P incorporation was completely reversed by an equimolar concentration of the thymidine at concentrations three times higher than that of FUdR. Other agents have what is called the x-ray type of effect; this effect is characterized by production of subchromatid exchange in prophase, chromatid aberrations in late or middle interphase (nondelayed effect), and chromosome aberrations in early interphase cells (delayed effect). With these agents, it was the nondelayed effect that consisted of chromatid exchanges and isolocus breaks with sister union, whereas chromosome type aberrations were obtained as a delayed effect. The chemicals, 8-ethoxycaffeine and streptonigrin, produced the delayed effect. (BBB)

Health Physics and Safety

Refer also to abstracts 26118, 26143, 26156, 26161, 26274, 26278, 26308, 26354, 26554, 26562, 26578, and 26594.

26402 (AD-641188) THRESHOLD DISTANCES FOR RETINAL BURNS FROM LOW-YIELD NUCLEAR DETONATIONS. [Period Covered]: January-February 1966. Richey, Everett O. (School of Aerospace Medicine, Brooks AFB, Tex.). July 1966. 16p. (SAM-TR-66-49). CFSTI $3.00 cy, $0.65 mn.

A method is given for predicting the threshold distances at which minimal retinal burns will be produced by nuclear detonations. This method relates calculated retinal exposure to experimentally determined burn threshold data. Predicted threshold distances are determined for the human eye exposed to sea-level, air-burst detonations from 0.01 to 10 kt. yield. The pupil diameter of the human eye is taken to be 2.5 mm. and 6.0 mm., respectively, for day and night conditions, and the effective focal length of the eye is taken to be 17 mm. The threshold distance for a bright daylight exposure with clear air (80 km.) visibility varies from about 1.3 to 11 km. as the detonation yield varies from 0.01 to 10 kt. Comparable distances for night exposures vary from 3.8 to 26 km. Calculations indicate that the use of a fixed filter with 2% transmission will result in retinal exposures more than an order of magnitude below the threshold exposure for these small daylight detonations. For nighttime conditions the retinal exposure is a factor of about 2.5 below the threshold exposure. (auth)

26403 (AD-644505) AN EXPERIMENTAL STUDY OF "INTEGRATED GUIDANCE FOR SHELTER MANAGEMENT." Final Summary Report. Smith, Robert W.; Bend, Emil; Jeffreys, Frank B.; Collins, Robert A. (American Institutes for Research, Pittsburgh, Pa. Inst. for Performance Technology). Sept. 1966. Contract OCD-PS-64-57. 13p. CFSTI $3.00 cy, $0.65 mn.

In 1965, the American Institutes for Research produced a set of documents designed to aid persons with shelter management responsibilities in carrying out both their peacetime and emergency duties. The first volume in the set is a training text which serves as an introduction to the subject of shelter management. The second volume is a guidance document for planning a group fallout shelter. The final document is for in-shelter use, to assist the management staff in organizing and operating a shelter under occupancy conditions. Together, the three documents make up an integrated guidance package which covers the broad range of information and action requirements for shelter planning and management. The objective of the research program described in this report was to obtain empirical data on the individual effectiveness of these guidance documents and to assess the effectiveness of various combinations of these materials in enhancing the peacetime and emergency shelter management functions. (auth)

26404 (ANL-7220) RADIOLOGICAL PHYSICS DIVISION ANNUAL REPORT, JULY 1965 TO JUNE 1966. (Argonne National Lab., Ill.). Contract W-31-109-eng-38. 124p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Eighteen papers and 15 summaries are presented in this report. Separate abstracts have been prepared for 16 of the 18 papers. Two papers on meteorological instrumentation were not abstracted for NSA. (W.E.B.)

For abstracts of individual papers see: 25986-25988, 26143, 26210-26212, 26263, 26264, 26327, 26328, 26405, 26551, and 26965-26967.

26405 (ANL-7220, pp 51-8) ^{226}Ra AND THE NATURAL AIRBORNE NUCLIDES ^{210}Pb AND ^{210}Po IN ARCTIC BIOTA. Holtzman, Richard B. (Argonne National Lab., Ill.).

Accumulation of the ^{210}Pb series in Arctic biota were studied in order to: establish the origin of the series; determine effects on the food chain and radiation effects; estimate possible accumulations in man; and investigate methods for reducing the accumulations. Analyses of ^{226}Ra, ^{210}Pb, and ^{210}Po were made in various types of Alaskan animals; ^{210}Po-^{210}Pb ratios are compared; and seasonal variations in the ^{210}Pb activity in bones and muscles of caribou and reindeer are discussed. Average contributions of ^{210}Po to the diet were estimated to probably be somewhat smaller than previously thought, owing to seasonal variations and radioactive decay during storage. Radium-226 contributions to the human diet from the caribou were found to be fairly low, being about 1 pCi/day from 900 g of meat. The source of the nuclide in caribou and other animals appears to be vegetation other than lichens, since most other plants contain little ^{226}Ra. (H.G.D.)

26406 (BNWL-SA-1212) ^{137}Cs IN CASCADE MOUNTAIN VEGETATION, 1966. Rickard, W. H. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr. 12, 1967. Contract AT(45-1)-1830. 13p. (CONF-670503-3). Dep. CFSTI.

From 2nd National Symposium on Radioecology, Ann Arbor, Mich.

The accumulated leaf litter collected from tree stands representative of the coniferous forests east and west of the Cascade Mountains of Washington State was analyzed for ^{137}Cs by gamma-ray spectrometric techniques in 1966. The litter of forest stands located in a high rainfall area west of the mountain summits had higher concentrations of ^{137}Cs (pCi/g) than did the litter of forest stands growing in a lower rainfall area east of the summit. However, on an areal basis (pCi/m^2), there was little difference between eastern and western stands. Sedges of a mountain bog growing in several decimeters of water had about 3 times more ^{137}Cs per gram dry weight than did the same kind of sedges near the bog margin but not growing in standing water. These data indicate that biologic processes as well as meteorologic processes are involved in the long-term accumulation of ^{137}Cs in forest floor litter and that a mobilization of ^{137}Cs from bog substrates is being accomplished by bog sedges. (auth)

26407 (BNWL-SA-1248) EFFECT OF HANFORD REACTOR SHUTDOWN ON COLUMBIA RIVER BIOTA. Watson, D. G.; Cushing, C. E.; Coutant, C. C.; Templeton, W. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). May 3, 1967. Contract AT(45-1)-1830. 21p. (CONF-670503-2). Dep. CFSTI.

From 2nd National Symposium on Radioecology, Ann Arbor, Mich.

Closure of the Hanford reactors for an extended period caused a rapid and extensive decline in concentration of radionuclides in the Columbia River biota. ^{51}Cr and ^{32}P decreased two or three orders of magnitude in the lower trophic levels; decline in concentrations of ^{65}Zn, ^{54}Mn, and ^{59}Fe was much less, suggesting a cycling of these nuclides from the sediments to the water during shutdown. In fish, ^{32}P was lost rapidly, ^{65}Zn slowly. Near equilibrium concentrations of radionuclides in most river organisms were approached within two weeks to one month after the resumption of reactor operation. (auth)

26408 (COO-1156-22) A STUDY OF THE FOOD CHAIN PATTERN OF ^{90}Sr, ^{137}Cs, AND ^{131}I IN A WILD DEER POPULATION. Technical Progress Report No. 5, January 1, 1966–December 31, 1966. Dahl, A. H.; Whicker, F. W.; Farris, G. C.; Hakonson, T. E. (Colorado State Univ., Fort Collins. Research Foundation). Feb. 1, 1967. Contract AT(11-1)-1156. 71p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Progress is reported on a study of the food chain pattern of fallout fission products, with emphasis on ^{137}Cs, ^{131}I, and ^{90}Sr, in a wild mule deer population grazing on the Cache la Poudre drainage area of Colorado, which allows study of the effects of variations in elevation, climate, and vegetative types upon the levels of radionuclide contamination in deer, forage plants, and soil. Data are included from metabolism cage studies of Cs metabolism in deer; the content of ^{137}Cs in skeletal muscles and in rumen samples of wild deer and on plant foliage; the content of ^{90}Sr in bones and antlers of wild deer of various ages; and the content of ^{131}I in adult and fetal thyroids and other tissues of wild deer. Data are also included on the content of ^{144}Ce, ^{54}Mn, and ^{106}Ru in liver tissues; the content of ^{144}Ce, ^{54}Mn, ^{106}Ru, and ^{95}Zr in lung tissues; and the content of ^{144}Ce, ^{137}Cs, ^{54}Mn, ^{106}Ru, ^{125}Sb, ^{90}Sr, and ^{95}Zr in forage plants sampled during 1966. (20 references.) (C.H.)

26409 (COO-1171-62) FOOD-CHAIN TRANSFER OF ^{137}Cs FROM TROPOSPHERE TO MAN. Annual Report No. 5. Ward, Gerald M.; Johnson, James E.; Wilson, Daniel W. (Colorado State Univ., Fort Collins. Dept. of Animal Science). Jan. 15, 1967. Contract AT(11-1)-1171. 88p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

CESIUM-137—uptake by forage plants of fallout, effects of content on air, rainfall, and soil on
FALLOUT—cesium-137 content in, Colorado, 1962 through 1965
CESIUM-137—transfer of fallout, from atmosphere to forage plants, mathematical model for
CESIUM-137—transfer of fallout, from forage food to milk and meat of domestic animals
MILK—cesium-137 content in, effects of cattle feeding practices on
CATTLE—uptake of potassium by, effects on cesium-137 content in milk
MAN—cesium-137 uptake by, from milk and meat from cattle and sheep
CESIUM-137—distribution of fallout, in food chain and body of man, mathematical model for prediction of
MATHEMATICS—model for cesium-137 transfer from atmospheric fallout through food chain to man
COLORADO—fallout monitoring, 1962 through 1966
FALLOUT—cesium-137 content in, in Colorado, 1962 through 1966
MAN—cesium-137 content in, effects of age, diet, potassium uptake, and sex on whole-body
CESIUM-137—content in man residing in Colorado, 1966, whole-body
CESIUM-137—removal from pasture forage plants of, effects of weathering conditions, grazing, and dilution during plant growth on
ALFALFA—cesium-134 uptake by, effects of foliar absorption on
CESIUM-134—uptake by man of, by skin absorption
MAN—cesium-134 uptake by, through skin absorption
MERCURY-203—distribution in man, biological half-life for
MAN—mercury-203 retention in, biological half-life of
RUBIDIUM-86—distribution in cows of injected, biological half-life in animal and milk of
CESIUM-137—content in rumen samples from grazing cattle
CATTLE—content of potassium in non-muscle tissues of
FOOD—cesium-137 content in cattle, effects of feeding practices on
CLAYS—cesium-137 fixation by, on plant surfaces
CESIUM-134—distribution in rats of, effects of dietary potassium on biological half-life of
FALLOUT—fission product transfer from, through food chain to man
BIBLIOGRAPHIES—fission product transfer from fallout through food chains to man (C.H.)

26410 (HOHF-3) RELATIONSHIP OF EFFICIENCY TO PRESSURE DROP OF RESPIRATOR CARTRIDGES WITH INTRODUCED DEFECTS. Adley, F. E.; Rolie, A. G. (Hanford Occupational Health Foundation, Richland, Wash. Occupational Hygiene Dept.). Feb. 1967. Contract AT(45-1)-1837. 6p. Dep. CFSTI.

Results are reported from tests on the full-face respirator masks used for radiological protection at Hanford. Emphasis was placed on the reliability of pressure drop as a test of the efficiency of the filter cartridges. It was concluded that pressure drop is not a valid or safe production screening criterion for respirator filter cartridge integrity and efficiency. (C.H.)

26411 (JAERI-1119) CONSTRUCTION AND OPERATION OF RADIOLOGICAL MONITORING POST. Ishihara, Toyohide; Shirotani, Takashi; Suga, Shinichi; Tatsuta, Hatsumi (Japan Atomic Energy Research Inst., Tokyo). July 1966. 44p. (In Japanese). Dep.

The principle, design, and operational characteristics of a monitoring post employed as an emergency field monitoring network system are described. This system is already in routine operation at the Tokai Research Establishment of the Japan Atomic Energy Research Institute. The monitoring post is installed at nine monitoring points within and at seven points outside of JAERI. A GM-counter is used as the detector, and these signals are transmitted through a coaxial cable (1 ~ 3km) to the central monitoring station equipped with rate-meters, recorders, and audio-visual alarm system. For the system of monitoring posts, a simple multi-signal transmission technique was developed. No troubles due to noises induced on the cable have occurred. The effective operation, attained in a given period, of the system is over 99 percent and its reliability is very high. (auth)

26412 (LA-3641) RADIATION LEVELS AT THE LOS ALAMOS TANDEM ACCELERATOR FACILITY. Engelke, Morris J.; Seitz, Thomas P.; Henkel, Richard L. (Los Alamos Scientific Lab., N. Mex.). Dec. 27, 1966. Contract W-7405-eng-36. 29p. Dep. CFSTI.

Radiation surveys were made of the Los Alamos tandem accelerator facility. The radiation levels of primary concern for health and safety were the γ radiation levels at the vertical accelerator and neutron levels around the tandem accelerator and at the control slits and target. Gamma radiation of over 4,000 R/hr was found, and neutron levels were found greater than 25 Rem/hr. These measurements were made inside the biological shield; no detectable radiation was found in areas of normal occupancy. (auth)

26413 (LA-DC-8473) ACCELERATING THE TURNOVER OF INTERNALLY-DEPOSITED RADIOCESIUM. Richmond, C. R. (Los Alamos Scientific Lab., N. Mex.). [1967]. Contract W-7405-eng-36. 39p. (CONF-670521-1). Dep. CFSTI.

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash.

Numerous attempts have been made to accelerate ^{137}Cs turnover from animals and man. These attempts include isotopic dilution, supplementation of K^+ and Cs^+, diuretics, hormones, ion exchangers, chelating agents, and natural food products. None of these materials proved of any significance when used in human subjects. Ferric ferrocyanide, a polymerized super complex, is the first material to effectively accelerate the turnover of internally-deposited ^{137}Cs. It is non-toxic and well tolerated. Also, its effectiveness is not dependent on the time when treatment begins, and the effect appears to be proportional to duration of treatment. Body potassium and sodium stores do not appear to be affected by treatment; binding to ferric ferrocyanide is apparently specific for the cesium ion. Ferric ferrocyanide is not absorbed into the body. It preferentially binds cesium ions in the lumen of the gut, thereby interrupting the enteral circulation and preventing reinsorption and deposition in tissues. (61 references). (auth)

26414 (NP-16660) ENVIRONMENTAL RADIOACTIVITY IN NEW ZEALAND. Quarterly Report, July–September 1966. (National Radiation Lab., Christchurch (New Zealand)). 55p. (NRL-F-22). Dep. mn.

Routine measurements of fallout made in New Zealand during the third quarter of 1966, and results of extended monitoring of fallout from French nuclear tests in the Pacific are reported. Strontium-10 and ^{137}Cs contents in rainwater and milk were comparable to those reported in the second quarter of 1966. The low value for the ratio of ^{89}Sr to ^{90}Sr indicates that most of the ^{90}Sr came from the stratosphere and hence little was contributed by the current tests. Levels of ^{90}Sr in rain during the quarter were less than ⅕ of the highest level previously recorded. Strontium-90 levels in milk during July and August were about ½ of the highest level previously recorded as were those for ^{137}Cs. Fallout levels in air and rainwater due to the long-lived bomb debris from the French tests continued to increase during the third quarter. (H.G.D.)

26415 (NP-16730) DATA FROM RADIATION PROTECTION PROGRAMS. Volume 5, Number 2. (Department of National Health and Welfare, Ottawa (Ontario). Radiation Protection Div.). Feb. 1967. 28p. Dep.

Data from radiation protection programs in Canada are given including: fallout monitoring of air particulates, precipitation, milk, water, wheat, soil and human bone. A report on reactor environment monitoring in Canada for January 1967 is included. (S.M.A.)

26416 (NYO-3364-34) RADIOCESIUM BODY BURDEN IN PEOPLE FROM MASFJORDEN. Madshus, Kjell (Norsk Hydro's Inst. for Cancer Research, Oslo); Stroemme, Aksel (Statens Radiologisk-Fysiske Laboratorium, Oslo (Norway)). [1966]. Contract AT(30-1)-3364. 13p. Dep. CFSTI.

Investigations of fallout radiocesium in milk from different parts of Norway were undertaken. It soon became obvious that milk produced in districts along the coast in the western and northern parts of the country had unusually high concentrations of ^{137}Cs. In this respect, special interest was focused on samples from Masfjorden, which is a community with the highest average annual rainfall. Milk samples from the Masfjorden district were analyzed each month. Eleven statistically selected subjects were examined for ^{137}Cs body content by a whole-body counter at Norsk Hydro's Institute for Cancer Research in Oslo. Results show that men had a higher ^{137}Cs body burden than women, due to fact that men eat much more meat, especially mutton which has a high concentration of ^{137}Cs. A comparison was made of the ^{137}Cs body content in those people from Masfjorden and a group from Eastern Norway. (S.M.H.)

26417 (ORNL-4101) DOSE-ESTIMATION STUDIES RELATED TO PROPOSED CONSTRUCTION OF AN ATLANTIC–PACIFIC INTEROCEANIC CANAL WITH NUCLEAR EXPLOSIVES: PHASE I. Cowser, K. E.; Kaye, S. V.; Rohwer, P. S.; Snyder, W. S.; Struxness, E. G. (Oak Ridge National Lab., Tenn.). Mar. 1967. Contract W-7405-eng-26. 221p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

This report presents information obtained by ORNL in Phase I of dose-estimation studies to evaluate the radiological-safety feasibility of excavating an Atlantic–Pacific interoceanic canal with nuclear explosives. The information includes (1) methods for estimating external and internal dose equivalents, for quantifying the transfer of radionuclides through critical exposure pathways, and for identifying the radionuclides likely to be critical; (2) criteria for evaluating the radiological safety of the operation; and (3) lists of radionuclides arranged according to the dose commitment that results from exposure to a unit quantity of each radionuclide. Equations to estimate external and internal radiation dose commitments were developed which account for production, venting, and movement of radionuclides in environmental exposure pathways. A compartment model for representing movement of radionuclides in the tropical environment was designed with coupled compartments having income and loss fluxes controlling the inventory of radionuclides which may have inputs to man. The specific-activity concept for estimating the allowable radionuclide concentrations in the environment was evaluated in a way that reveals its limitations, considering the time-dependent relative importance of radioactive half-life, biological half-time, and biological growth. Criteria for evaluating radiological safety were developed from the recommendations of recognized authorities which might reasonably apply in an operation of this magnitude, taking account of the principle of balancing the possible benefits against the potential risks. (auth)

26418 (PG-Report-771) HEALTH AND SAFETY RESEARCH AT CHAPELCROSS, ANNUAL REPORT, 1966. Martin, J. H. (United Kingdom Atomic Energy Authority, Annan (Scotland). Production Group). 1967. 8p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. HMSO 1s. 9d.

Progress is reported on studies on neutron dosimetry. Studies of depth dose distributions in tissues for fast neutron energies up to 14 MeV were completed. Differences between the experimental and theoretical results for thermal neutron depth dose distribution produced by incident fast neutrons indicated that the theory should be modified to include molecular binding effects on the scattering cross-section and the dose must be calculated from the neutron collision-density by averaging the thermal neutrons over the Maxwellian distribution of energies. It was found that the shape of the thermal neutron distribution can be described adequately using two group diffusion theory. A practical method for determining the LET distribution of dose for proton recoils at depth in tissue was evolved using a plastic phosphor. Investigations on the physical properties of heavy ions were continued. The dose equivalent at the body surface for isotropic irradiation by cosmic ray neutrons was calculated to be 6.2 ± 0.5 mRem/yr at Chapelcross and at supersonic transport altitudes was calculated to be 0.2 ± 0.02 mRem/hr. Progress is reported on studies on the effects of whole-body x irradiation, at doses up to 1000 R, on the metabolism of thymine and tryptophan in rats and rabbits. Stressing of metabolic pathways by oral loading with thymine or tryptophan proved to be a sensitive technique to identify a metabolic lesion in irradiated animals. Citrate, given within one hour, was found to induce urinary excretion of up to 15% of ^{237}Pu injected into experimental animals. (C.H.)

26419 (RA-15) JODIUM-131 IN MELK EN GROENTEN GEDURENDE DE LAATSTE HELFT VAN 1961. (^{131}I in Milk and Vegetables During the Last Half of 1961). Strackee, L.; Mattern, F. C. M. (Rijks Instituut voor de Volksgezondheid, Utrecht (Netherlands)). July 1962. 15p. (In Dutch). Dep. mn.

Results are given of the measurements of I-131 in milk and vegetables in The Netherlands, after the resumption of nuclear weapons testing in September 1961. The average concentration in milk during the last four months of 1961 is an estimated 80 pC/l. The radiation dose to the thyroid of children under 1 year of age, considered to be the most exposed group of the whole population, was calculated to be approximately 80 millirad. This is 16% of the maximal permissible dose to this organ for the population at large under normal peacetime conditions. (auth)

26420 (SC-CR-66-2144) RADIOLOGICAL SAFETY STUDIES OF SPACE NUCLEAR SYSTEMS. Quarterly Report No. 1, September 13–December 13, 1966. Coleman, J. R.; Denham, R. S. (NUS Corp., Washington, D. C.). Jan. 1967. Contract 48-4310. 39p. Dep. CFSTI.

For Sandia Corp., Albuquerque, N. Mex.

This is the first quarterly report under Contract 48-4310 for the development and application of radiation dose and interaction probability models for dispersed and intact re-entry modes of isotopic SNAP units, comparison of the re-entry modes and their radiological consequences, and such other assistance as may be required on special questions which arise during safety evaluations of SNAP systems. The purpose of Task I of this contract was primarily to define and consider those portions of the overall problem which will require the greatest modification of the Rover Flight Safety Analysis. Concern in this early stage was directed primarily at movement of materials through the environment to man. Portions of the food chain including vegetation and meat were considered and the new ICRP lung model was generalized as much as possible for application to this project. Efforts under Task II were limited to collection and review of imput information on SNAP-19, which uses ^{238}Pu as a power source, and SNAP-29, which uses ^{210}Po. Possible problem areas with the safety analysis of SNAP-19 were identified. Work presently in progress under Task IV includes development of generalized safety criteria for aerospace systems and calculation of radiation dose to tissue from spherical particles of isotopic fuel materials. (auth)

26421 (SC-RR-66-2679) RADIOLOGICAL HEALTH ASPECTS OF ^{170} ^{171}Tm OXIDE. Everett, R. J. (Sandia Corp., Albuquerque, N. Mex.). Feb. 1967. Contract AT(29-1)-789. 30p. Dep. CFSTI.

Thulium-170, -171 oxide is examined as to properties and consequences of human exposure. Properties are listed that relate to the radiation hazard. Dose and effect relationships are proposed based upon presently available data. Specific biological data about thulium are quite rare; however, reasonable predictions are made by using data on stable rare earth compounds and general models for deposition and retention. Dose comparisons are made between thulium and other insoluble fuel materials to assist in fuel selection. Thulium compares favorably with most fuel materials, but suffers somewhat from low power output and, therefore, incurs some weight penalty. It is noted that the properties of an isotope that make it a desirable thermoelectric fuel material for terrestrial and space application also contribute directly to its biological hazard; however, individual physical and chemical properties often reduce the hazard or lower the probability of interaction with humans. (auth)

26422 (UCRL-50007-66-2) HAZARDS CONTROL PROGRESS REPORT NO. 26, SEPTEMBER-DECEMBER 1966 AND INDEX TO HAZARDS CONTROL PROGRESS REPORTS NOS. 24 THROUGH 26. (California Univ., Livermore. Lawrence Radiation Lab.). Contract W-7405-eng-48. 58p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Separate abstracts were prepared on nine sections of this report. (C.H.)

For abstracts of individual papers see: 26156–26159, 26243, 26244, 26278, 26423, and 26424.

26423 (UCRL-50007-66-2, pp 30-3) STRIPCOAT REMOVAL OF ALPHA CONTAMINATION ON FLOORING SURFACES. Gaskill, J. R.; Kathren, R. L. (California Univ., Livermore. Lawrence Radiation Lab.).

The effectiveness of a fire-retardant strippable coating applied by means of a pressurized spray can; a nonfire-retardant strippable coating, containing 20% polyvinyl chloride solids; and an aqueous emulsion floor sealer were tested for the removal of α contamination from concrete or vinyl-asbestos tile flooring surfaces. Samples of flooring materials placed in a gloved box were contaminated by dispersing 5.0 ml of ^{239}Pu solution, were monitored after drying with an α-proportional counter, after which the surfaces were painted or sprayed with the strip coatings, and they were re-monitored after the coatings had dried. Attempts were then made to strip the coatings and the surfaces were monitored again. Results showed that the fire-retardant strip coating could be used to tie down α contamination but removal of the strip coatings removed only small amounts of contamination. It appeared that most contamination involved attack of, or penetration into, surfaces and that strip coatings are of questionable value as decontaminating agents. (C.H.)

26424 (UCRL-50007-66-2, pp 33-7) EFFECT OF HUMIDITY ON THE CAPACITY OF CHARCOAL TO ABSORB METHYL IODIDE. Lindeken, C. L.; Santomassimo, V. C.; Nelson, G. O. (California Univ., Livermore. Lawrence Radiation Lab.).

The effect of humidity on the capacity of charcoal to absorb methyl iodide was investigated in the charcoal filter system for a reactor off-gas air cleaning system and in charcoal respirator cartridges. Based on the respirator cartridge tests, it appeared that the methyl iodide technique used in testing the reactor off-gas charcoal bed was questionable. The rapid desorption rates of methyl iodide from the cartridges emphasized the fact that cartridges should not be reused after possible exposure to methyl iodide. (C.H.)

26425 EFFECT OF CHRONIC EXPOSURE TO PULSED AND NONPULSED 10-CM WAVES ON THE CONDITIONED-REFLEX ACTIVITY OF WHITE RATS. Lobanova, E. A. (Inst. of Industrial Hygiene and Occupational Diseases, Academy of Sciences, USSR). Gig. Truda Prof. Zabolev., No. 10, 7-12(1966). (In Russian).

Most dosimeters used for the measurement of microwave fields are capable of measuring only the average field power density. Here, the power of a pulse (assuming pulsed generation) is overlooked. The power of a typical microwave pulse exceeds the average measurable field power density by 100 or 1000. This problem is important relative to the biological effects of microwaves. Pulsed and nonpulsed microwaves have a virtually identical biological effect, save for initial reactions to these two regimes. In view of the demonstrated high sensitivity of the central nervous system (CNS) to this factor, the author conducted a well-controlled, reflex-oriented experiment on rats exposed to pulsed and nonpulsed 10-cm waves. The field power density was 40 mw/cm^2. The duration of exposure was 15 min and experimental animals were irradiated a total of 99 times over a period of 4 months. Fourteen rats were divided into three groups: (1) group exposed to pulsed microwaves; (2) group exposed to nonpulsed microwaves; (3) paired controls exposed to identical experimental conditions and studied at the same time as experimental animals. The Kotlyarevskiy method of developing conditioned reflexes was employed. The positive stimulus was a rather strong 600-cps tone and green light (a rather weak stimulus). Differentiation to a 300 cps tone was developed. It was found that shifts in reflex activity characterized by disinhibition and a depression of reflex activity were identical as a result of exposure to pulsed and nonpulsed microwaves. However, the effects of pulsed microwaves were more pronounced and occurred earlier (during the 1st to 19th exposure). On the other hand, reflex shifts in animals exposed to nonpulsed radiation occurred considerably later (during the 81st to 99th exposures). The cause of all observed shifts was concluded to be a weakening of basic neural processes caused by microwaves. (TSS)

26426 EQUIPMENT FOR THE PRODUCTION OF GAMMA-RAY BEAMS. Makra, Zsigmond; Meszaros, Istvan. KFKI (Kozp. Fiz. Kut. Int.) Kozlem., 15: 105-13(1967). (In Hungarian).

A calibrating facility for the production of gamma rays in the range of dose rates from 0.1 to 100 R/h is described. The radiation sources are stored in three containers. A selected container is conveyed under the irradiator on rails. The radiation source is lifted into position for irradiation and is lowered back to its container by an electro-pneumatic mechanism. The minimum 4° and maximum 13.5° width of the irradiating beam is set by interchangeable collimators. The facility is operated with ^{60}Co and ^{137}Cs sources and is used for the calibration of health-physics survey meters. (auth)

26427 ^{192}Ir FOR TUMOR IMPLANTS WITH DIRECT DOSE MEASUREMENTS. Simon, Norman (Mt. Sinai Hospital, New York). N. Y. State J. Med., 67: 424-5(Feb. 1, 1967).

Advantages, especially safety features, in the use of ^{192}Ir implants over Ra are discussed and problems in dosimetry with ^{192}Ir sources are considered. The dosimetry of ^{192}Ir implants presents some clinical problems since ^{192}Ir seeds are received for use from the supplier in milligrams of Ra equivalents. The radiation strength of the seeds is determined by comparing their output of radiation with that of a known Ra source. Clinical observations suggested that there may be an increase in the biologic effect when such calibration of seeds is accepted. For instance, skin reactions over an implanted tumor were more intense than expected, and late telangiectases in the oral cavity were more intense than predicted. Thus, direct measurements of absorbed doses from ^{192}Ir implants were made with thermoluminescent dosimeters. Preliminary tests of precision of the lithium fluoride-Teflon rods, 1 mm in dia and 6 mm in length, showed results within ±10% at exposures of 10 to 1000 R of ^{60}Co γ radiation. Other preliminary tests using known doses with lower energy radiation, 45- and 200-kV x rays, checked to within 20% of calibrations obtained with ionization chambers. Dosimeters of lithium fluoride-Teflon were placed 0.5 and 1 cm from the ^{192}Ir implant in a linear distribution diagonally across the implant. Doses estimated by the use of the data of Paterson and Parker for these model implants with Ra and ^{192}Ir were within 10% of the doses measured by the lithium fluoride-Teflon dosimeters. This close check showed that the direct measurement of implants was feasible and accurate. (TSS)

26428 THE EXTENT OF THE INTERNAL CONTAMINATION OF AN ORGANISM IN A REGION OF RADIOACTIVE FALLOUT. Chernenko, G. T.; Mol'kov, A. G. Voenno-Med. Zh., No. 2, 22-6(Feb. 1967). (In Russian).

Although the main hazard from radioactive fallout is from the external gamma radiation, it is desirable to estimate the internal dose due to inhalation which is calculated from the following formula: $Q = K\ V\ C\ t$. Here Q is the internal contamination in μC; K is the retention coefficient for the holdup of radioactivity in the respiratory tract (K is assumed to be equal to 0.7); V is the respiratory volume for a man under moderate labor, which is equal to 21/l min; C is the concentration of radioactivity in μC/l; t is the time of residence in the fallout zone in minutes. The value of C is calculated from the relation: $C' = 5 \times 10^{-7}$ P. Here P is the gamma dose rate in r/hr, and C′ is the radioactive air contamination in curies/l. At gamma dose rates of 1, 10, 20, and 100 r/hr, the inspired activities are 0.22, 2.2, 4.4, and 22 μC entering the organism in a period of one hour. The maximum allowable dose to the thyroid is 30 r/yr which can be imparted by ~1 μC of mixed, fission-product activities. Hence, inhaled activities of 4 to 22 μC must be considered as dangerous to the body. Measures should be taken to prevent the entrances of fallout fission-products into the body. (TTT)

26429 RADIOACTIVE CONTAMINATION OF OUR ENVIRONMENT FOLLOWING NUCLEAR BOMB TESTS, AND RADIATION-

INDUCED CANCER. **Devik, Finn (Statens Institutt for Stralehygiene, Oslo). Tidsskr. Norske Laegforen., 85: 1779-81(Dec. 1, 1965). (In Norwegian).**

Radiation hazards resulting from human intake of fallout radionuclides are discussed in relation to the conclusions and recommendations of the Third Report of the United Nations Scientific Committee on the Effects of Atomic Radiation (New York 1964). The report gives an estimate of environmental radiation dose from radioactive fallout in 1965, and reviews data pertinent to dose-effect relations with respect to malignant diseases. The author points out that the average fallout radiation dose to the population in Norway is not likely to differ by any considerable factor from the average values calculated for the world's population, but local variations may be considerable and merit further investigations. In this connection it is mentioned that common terms such as radiation hazard, danger, risk, etc., when used in public discussions are not always adequate. They should be avoided unless it is made clear what they are intended to convey, or they should be replaced by unequivocal terms. Other aspects of fallout hazards considered are: levels of ^{90}Sr, ^{37}Cs, and ^{14}C in the biosphere, effects on humans of low-dosage irradiation as reported in atomic bombing survivors, and recommendations of the international committees for measures for radiation protection. (BBB)

26430 BELGIAN LEGISLATION IN RELATION TO PROTECTION OF THE PUBLIC AND THE WORKMEN AGAINST IONIZING RADIATION. Hublet, P. Arch. Belg. Med. Soc., Hyg., Med., Travail Med. Legale, 23: 168-72(Mar. 1965). (In French).

Three laws enacted in Belgium in 1963 to protect workers against ionizing radiations are described. In general, the standards prescribed by Euratom were followed. The physical and biological bases for such protection are discussed, particularly the concept of relative biological effectiveness. The maximum permissible doses are calculated as a function of age and are based on an annual dose of 5 rem. The maximum 13-week dose cannot exceed 3 rem. Pregnant women and persons under the age of 18 are forbidden to be occupationally exposed to radiation. The laws make it mandatory for employers to keep adequate records of personnel exposure and to submit three copies of these records to the Ministry of Health. Provisions are also made for monitoring exposure and periodic and/or special health examinations for all exposed workers. Special examinations would be required if film badge dosimetry recorded excessive exposure. (BBB)

26431 FALLOUT SHELTER SURVIVAL RESEARCH. **Hammes, John A.; Osborne, R. Travis (Univ. of Georgia, Athens). J. Clin. Psychol., 22: 344-6(July 1966).**

The threat of nuclear war has initiated investigation into the survival aspects of fallout shelter confinement. Several 2-week occupancy tests have been conducted by various organizations interested in this problem. The characteristics of these studies, presented in tables, show that the confinement tests conducted at the University of Georgia surpass in austerity all previous shelter research using civilians. The general research mission was to appraise minimal survival conditions in public fallout shelters as presently equipped and stocked with emergency supplies. Specifically, the project was to evaluate the interactive effects of such variables as overloading, limited bunks and bedding, emergency sanitation equipment, marginal ventilation conditions, and minimal food and water supplies. A film depicting results was also part of the research mission. Four experimental studies were conducted and are described. These studies indicated that healthy men, women, and children can endure 2-week isolated shelter confinement under conditions of severe austerity without suffering deleterious physiological or psychological effects. Secondly, Office of Civil Defense supplies as presently stocked in public fallout shelters appear to be sufficient for healthy men, women, and children for a 2-week survival period. However, caution should be exerted in extrapolating these findings to realistic conditions of actual nuclear war. (BBB)

26432 EFFECTIVE USE OF THE WHOLE BODY COUNTING TECHNIQUE IN A RADIATION PROTECTION PROGRAM. Johnson, L. J. (Idaho Nuclear Corp., Idaho Falls). Health Phys., 13: 659-61(June 1967).

The radiation protection program implemented by Phillips Petroleum Co. at the National Reactor Testing Station is referred to. The bio-assay program includes in vivo determinations of radionuclides, that is, whole body counting. The latter technique provides a means of measuring the effectiveness of a radiation protection program in minimizing internal exposure. Since July 1961, more than 3000 whole body count examinations were made on personnel whose assignments involved the greatest exposure potential (by the USAEC Idaho Operations Office). The sensitivity of the detecting system used permitted measurement of a few nanocuries of most gamma emitting nuclides. Results are analyzed and discussed. It was shown that the radiation protection program was effective in preventing or minimizing internal exposure of personnel. (UK)

26433 SOME FACTORS CONTRIBUTING TO THE INTERNAL RADIATION HAZARD IN THE RADIUM LUMINISING INDUSTRY. **Duggan, M. J.; Godfrey, B. E. (Radiological Protection Service, Sutton, Eng.). Health Phys., 13: 613-23(June 1967).**

A study of working methods and conditions in the radium luminising industry, and associated measurements of the radium body contents of the workers, are described. The results obtained from twenty-three luminising establishments, providing seventy-five workers for body radioactivity measurements, are summarised and discussed. High radium body contents were found in some workers from the most heavily contaminated establishments, and values of surface contamination indicative of unsatisfactory working conditions are deduced. (auth)

26434 CONCENTRATIONS OF ^{210}Pb AND ^{210}Po IN HUMAN SOFT TISSUES. **Blanchard, R. L. (Dept. of Health, Education, and Welfare, Cincinnati). Health Phys., 13: 625-32(June 1967).**

Concentrations of ^{210}Pb and ^{210}Po in tissues from twenty individuals are reported. The tissues investigated were the kidney, liver, lung, pancreas, spleen, gonads, thyroid, and heart. The two highest average ^{210}Po concentrations were 14.5 and 11.3 pCi/kg in liver and kidney, respectively. Average concentration in gonads, lung and thyroid was about one-half of these values and the least amounts of ^{210}Po and ^{210}Pb were found in the spleen, pancreas, and heart. Higher concentrations of ^{210}Po were found in tissues of cigarette smokers than nonsmokers. Except for the lung, however, the differences were not significant. The ^{210}Po/^{210}Pb activity ratio varied from <1 to >1 in all tissue types, except for the heart, for which there were too few samples to be meaningful. The amount of ^{210}Po unsupported by its ^{210}Pb parent was greatest in the kidney. The dose rates delivered by the ^{210}Po to the various tissues are discussed. (auth)

26435 EFFECT OF MERCUHYDRIN ALONE AND IN CONJUNCTION WITH AMMONIUM CHLORIDE ON RADIOSTRONTIUM EXCRETION IN MAN. **Spencer, Herta; Menczel, Jacob; Samachson, Joseph (Veterans Administration Hospital, Hines, Ill.). Contract AT(11-)-1231-22. Proc. Soc. Exp. Biol. Med., 124: 1110-16(Apr. 1967).**

To determine the effect of enhanced diuresis on radiostrontium excretion, the diuretic agent Mercuhydrin, which potentiates the diuretic action of ammonium chloride but does not cause acidosis, was used alone and in conjunction with ammonium chloride in studies performed under constant conditions in man. The diuresis induced by intramuscular injections of Mercuhydrin at varying time intervals following intravenous or oral administration of ^{85}Sr was associated with an inconsistent and only slight increase in urinary ^{85}Sr excretion despite a concomitant increase in urinary calcium excretion. Following discontinuation of Mercuhydrin there was a marked inhibition of the urinary excretion of ^{85}Sr and calcium. Further increase in urine volume induced by Mercuhydrin used in conjunction with ammonium chloride resulted in a marked increase in urinary calcium but not in further enhancement of ^{85}Sr excretion. Mercuhydrin actually diminished the effect of ammonium chloride by inhibiting ^{85}Sr excretion following discontinuation of this combined therapy. This rebound inhibition of ^{85}Sr excretion contrasts with the sustained increase in ^{85}Sr and calcium excretion following discontinuation of ammonium chloride. (S.M.J.)

26436 GENERAL STUDIES ON RADIATION ACCIDENTS. REPORT PRESENTED AT THE SYMPOSIUM ON ACCIDENTAL IRRADIATIONS IN INDUSTRY. **Recht, P. J. Belge Radiol., 50: 96-110(1967). (In French).**

This survey comprises two parts. The first part is devoted to a list of accidental irradiations, as compiled from an analysis of certain information supplied, and to the general lessons that can be learned therefrom. Whereas the most serious accidents have so far occurred in critical assemblies, experimental reactors and chemical plants, the scattered location of other radioactivity sources presents a number of problems as regards regulations and control. The second part deals with the administrative and medicolegal aspects of accidental irradiations and the author raises various problems and questions concerning the meaning of the term "accidental irradiation" and its medico-legal implications, by considering the immediate effects, the threshold doses and the delayed effects. (auth)

26437 REMARKS ON MODELLED APPARATUS FOR ENDO-ORAL CONTACT RADIUM THERAPY. **Agati, G.; Guasta, G.; Negro, G. C. (Univ., Turin). Minerva Radiol., Fisioterap. Radiobiol., 12: 48-52(Jan.-Feb. 1967). (In Italian).**

With the object of improving the protection of healthy tissues of the oral cavity during contact radium therapy, the use of modelled apparatus with complete lead lining is proposed. Reference is made to the preliminary dosimetric evaluations proving the effectiveness of this protection, the various construction of the apparatus, and the measures to be taken for their correct use in practice. (TSS)

26438 RADIOCHEMICAL DETERMINATION OF ^{226}Ra IN HUMAN TOOTH AND URINE. Penna Franca, Eduardo; Lobao, Nazyo; Teitakowski, Marlene; Londres, Helena (Universidade do Brasil, Rio de Janeiro). An. Acad. Brasil. Cienc., 38: 121-36(Jan.-Mar. 1966).

Radium-226 determinations in human teeth and urine samples were compared for residents of areas of high and low natural radioactivity in Brazil. Two types of high background areas were included in the study: a region of monazite sands along the coast and a region containing volcanic intrusives. No statistically significant differences in ^{226}Ra levels were found in the teeth from residents of monazite sands and those from inhabitants of regions of low natural radioactivity. However, average ^{226}Ra contents in teeth collected in regions of volcanic intrusions were considerably higher, a finding attributed to the consumption of food produced in contaminated areas. There was no correlation between age and radium concentrations in teeth. Values for urine samples were higher in both areas of high natural radioactivity than in Rio de Janeiro, but were comparable to values for urine collected in villages with similar socioeconomic background that were located in areas of low natural radioactivity. The lower radium content in urine samples from Rio de Janeiro were related to higher calcium contents in these samples. Socioeconomic analyses of ^{226}Ra concentrations in the regions of high natural radiation showed that contamination was generally higher in families belonging to the lower socioeconomic groups. (H.G.D.)

26439 PROBLEMS OF ABSORBED DOSE IN THE SURGICAL APPLICATION OF RADIOISOTOPES. Cavalli, A.; Catolla Cavalcanti, R.; Semeraro, D.; Cacciari, P. (Univ., Turin). Minerva Radiol., Fisioterap. Radiobiol., 12: 53-4(Jan.-Feb. 1967). (In Italian).

Some preliminary studies on dosimetrical problems in the surgical application of radionucleides are reported. Thermoluminescence fluorine of lithium dose meters were employed in the research. (TSS)

26440 CONCENTRATION OF RADIONUCLIDES BY PLANTS GROWN ON EJECTA FROM THE SEDAN THERMONUCLEAR CRATERING DETONATION. Romney, E. M.; Steen, A. J.; Wood, R. A.; Rhoads, W. A. (Univ. of California, Los Angeles). pp 391-8 of Radioecological Concentration Processes. Proc. Intern. Sympos., Stockholm, Apr. 25-29, 1966. Oxford, Pergamon Press, 1966.

A study was made of radionuclide concentration by plants grown on Sedan ejecta during the 3-yr cropping period following the detonation of a 100-Kt thermonuclear device at a depth of 194 m in the desert alluvium of Yucca Flat, Nevada, on 6 July, 1962. The explosion ejected $\sim 5 \times 10^6$ m^3 of material forming a symmetrical crater 364 m in dia and 99 m deep. Samples of Sedan ejecta taken from different locations around the crater were used to grow alfalfa (*Medicago sativa*), barley (*Hordeum vulgare*), and beans (*Phaseolus vulgaris*) under dust-free glasshouse conditions. These plants concentrated very high levels of radiotungsten through their roots. Smaller, yet significant amounts of ^{46}Sc, ^{54}Mn, ^{60}Co, ^{88}Y, ^{89}Sr, ^{90}Sr, ^{95}Zr, ^{106}Ru, ^{125}Sb, ^{134}Cs, ^{137}Cs, and ^{144}Ce also were concentrated through roots. Uptake of these radionuclides persisted through the 3-yr cropping period of this study. The γ spectrum continued to be dominated by ^{88}Y, ^{95}Zr, ^{106}Ru, ^{144}Ce, ^{181}W, and ^{185}W. Plant foliage contaminated by Sedan fallout also showed ^{86}Rb, ^{91}Y, ^{102}Rh, ^{103}Ru, ^{131}I, ^{136}Cs, ^{140}Ba, ^{141}Ce, ^{152}Eu, and ^{154}Eu; but these radionuclides were not concentrated through roots in later cropping experiments. Radioactive dust continued to be deposited on the foliage of plants re-established on Sedan ejecta after the detonation occurred. (BBB)

26441 STUDY UPON THE SORPTION OF THE RADIOACTIVE FALLOUT ON SUITING AND DECORATIVE TEXTILES. Luczak, Jerzy (State Inst. of Hygiene, Warsaw). Rocz. Panstw. Zakladu Hig., 18: 9-15(1967). (In Polish).

The ability of nine suiting and decorative textiles to adsorb atmospheric radioactive fallout was investigated. The sorption was greatest in all textiles studied after spring exposure. The textiles of natural fibers and textiles containing a mixture of natural and synthetic fibers accumulated significantly more radioisotopes than textiles of synthetic fiber alone. The sorption of radioactive isotopes was increased with increase of the thickness of the textile. (tr-auth)

26442 ^{90}Sr IN MAIZE FIELD, CATTAIL MARSH, AND OAKWOOD ECOSYSTEMS. Ovington, J. D. (Australian National Univ., Canberra); Lawrence, D. B. J. Appl. Ecol., 1: 175-81 (May 1964).

In Minnesota in late 1959, the above-ground parts of cattail and maize ecosystems at Cedar Creek contained 4.4 and 2.8 μCi/ha of ^{90}Sr, respectively, much less than the annual fallout. These amounts were similar to those found in the vegetation of Minnesota pastures. In the pastures the ^{90}Sr content of the vegetation was only a few per cent of that in the root mat and top 5 cm of soil, so that much of the ^{90}Sr in the maize field and cattail marsh was probably also in the soil and not in the living plants. In contrast, the trees of the oakwood contained much more ^{90}Sr (48.2 μCi/ha) than the living plants of the other ecosystems. The total ^{90}Sr (136 μCi/ha) in the organic matter in the oakwood at Cedar Creek was in the range reported for the total ^{90}Sr in the vegetation, root mat, and surface soil of pastures under roughly comparable rainfalls in Minnesota and Great Britain. Since the accumulation of ^{90}Sr in terrestrial ecosystems is fairly uniform for comparable localities, much of the ^{90}Sr in the woodland is likely to be in the organic matter and relatively little in the mineral soil. The oakwood clearly differs greatly from the herbaceous ecosystems in respect of the distribution and anticipated rate of movement of ^{90}Sr. Oak leaves contained only 3.33 μCi/ha of ^{90}Sr, much less than the more persistent living branches, trunks, dead branches, and litter (20.03, 11.08, 13.76, and 88.23 μCi/ha respectively). (BBB)

26443 DIETARY ^{90}Sr REDUCTIONS THROUGH FOOD SUBSTITUTIONS IN THE FRUIT AND VEGETABLE CATEGORY. Thompson, J. C. Jr.; Alexander, R. R.; Comar, C. L. (Cornell Univ., Ithaca, N. Y.). J. Nutr., 91: 375-82(Mar. 1967).

The extent to which fruits and vegetables contribute to intake of ^{90}Sr was assessed. Information of this type may be useful for assessment of risk to special population groups or for those who may follow dietary habits that tend to increase dietary levels of ^{90}Sr/Ca (for example, high plant food intake, minimal milk consumption, and minimal processing of foods). Such groups should be among the first to be considered following incidents that produce increased environmental and radiocontamination. Estimates are presented of the reductions of ^{90}Sr intake that can be obtained by practical shifts of consumption within the fruit and vegetable category, with attention being given to maintenance of nutritional balance. The maximal effect from modifications in patterns of consumption and routine processing of fruits and vegetables occurs with a diet of minimal dairy products and amounts to about a 40% reduction in ^{90}Sr/Ca intake. (BBB)

26444 FILM DOSIMETERS WITH WIDE MEASURING RANGE BY CHANGES IN THE EMULSION AND CONDITIONS OF DEVELOPMENT. Kiss, I.; Koczkas, J.; Bojtor, I. (Inst. for Radiobiology and Radiation Hygiene, Budapest). Roentgen Bl., 18: 120-6(Mar. 1965). (In German).

Problems encountered in using photographic film for dosimetry of ionizing radiations over a wide dose range are discussed. A description is given of a new film dosimeter that consists of a combination of three commercially available film types: x ray, cinepositive, and microfort film. The applicability of the different types of emulsions within a large range of doses was achieved by means of a developer with a high buffering power that contained phenylmercapto-tetrazol. For x-radiation dosimetry the x-ray film covers the range 30 to 4000 mR, the cinepositive film 2 to 200 R, and the microfort film 20 to 2000 R. Thus, the dosimeter covers doses ranging from 30 mR to 1000 R. It is proposed that the dosimeter can be used not only for patient dosimetry but also for the registration of the radiation effect on the population due to diagnostic x-ray procedures and for the dosimetry of heavy radiation exposure. (BBB)

26445 CONTRIBUTION OF INDIVIDUAL FOODS TO THE INCORPORATION OF ^{90}Sr AND ^{137}Cs. Ritter, R. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). Z. Lebensm.-Untersuch. Forsch., 129: 325-32(1966). (In German).

The contribution of individual types of food to the total radiation burden of the German people between 1960 and 1964 was studied. The individual food types discussed were milk, cereal and cereal products, potatoes, vegetables, fruits, meat, and fish. The results are shown graphically and tabulated. (J.S.R.)

26446 RADIOFREQUENCY ELECTROMAGNETIC FIELDS AS A HYGIENIC FACTOR. Gordon, Z. V. (Inst. of Industrial Hygiene and Occupational Diseases, Academy of Sciences, USSR). Gig. Truda Prof. Zabolev., No. 10, 3-6(1966). (In Russian).

Presently, special sensors are used to measure the intensity of microwave fields: The IEMP-1 is used to measure the voltage of the electrical and magnetic components of a field and the PO-1 is used to measure the power density. Both sensors are only capable of measuring the energy reaching the surface of a body. The mechanism of microwave absorption, especially by the heterogeneous structures of a living organism, is extremely complex and little studied. The author tabulated present maximum permissible dose norms for the entire radiofrequency range. On the basis of other studies, a more stringent irradiation standard is needed for the 30–300 Mc range (λ = 1.5–2.0 m) than the 5 v/m specified. The central nervous system has been found to be particularly sensitive to these fields, reacting to doses below the threshold necessary to produce reactions in other systems and structures. The effect of radiofrequency EMF's on sexual functions is considered to be of great importance in future investigations. The combined effects of radiofrequency EMF's and other industrial factors are also considered to be important in relation to future studies. Finally, of no less importance is the development of methods for revealing the mechanisms of radiofrequency EMF effects. (CFSTI)

26447 EFFECT OF ABSORPTION AND DISPERSION OF X-RAYS ON A DISTRIBUTION OF DOSES IN NONUNIFORM MEDIUM BEYOND THE CENTRAL BEAM OF RADIATION. Lobodziec, Wlodzimierz; Goralczyk-Piech, Alicja. Nowotwory, 17: No. 1, 71-6(Jan.-Mar. 1967). (In Polish).

A difference in absorption of x rays in aluminum depending on a surrounding medium (water, air) was studied. In these experiments aluminum was accepted as a material corresponding to the bone tissue. The measurements were made for x rays with half-energy loss in copper 0.74 and 1.6 mm. The results of measurements are presented in the form of plots. (auth)

26448 ^{40}K AND ^{137}Cs MEASUREMENTS WITH THE WHOLE-BODY COUNTER OF BOLOGNA. Melandri, C.; Prodi, V.; Rimondi, O. (CNEN, Bologna). Panminerva Med., 7: 372-7 (Oct. 1965).

The design and construction of a whole-body counter are described, as well as its use to monitor natural radioactivity and fallout contamination of the human body. The shielded room is built with steel bricks 16 cm thick and with inner dimensions of 2.70 × 2.10 × 2.10 m, so as to allow widely differing geometrical arrangements. For γ-ray detection a 9 × 4 in. Na(Tl) cylindrical crystal is used. The background inside the room is 1471 cpm in the 0.1- to 1.9-MeV energy range. With this unit ^{137}Cs and ^{40}K were measured in 14 individuals, average levels for ^{137}Cs were found to be 7.0 mμCi and for ^{40}K 2.0 g/kg bodyweight. A large plastic scintillation unit (30 × 20.2 × 17 cm) scanned by 2 EMI-9530 5-in. photomultiplier tubes was also tested and found to be satisfactory. Two or 3 units of this kind, set up in parallel, serve as a highly efficient, inexpensive scanner. (BBB)

26449 BASIC PRINCIPLES FOR THE USE OF RADIOACTIVITY IN MEDICINE. A REVISION. VII. PRACTICAL APPLICATION OF RADIATION PROTECTION. Rach, K. (Univ., Berlin). Roentgenpraxis, 19: 89-95(Apr. 1966). (In German).

Data are given on the basic principles for the use of radioactive material in medicine. Chemical radioprotection is obtained through the use of sulfhydryl compounds, such as cysteine and cysteamine. The effects of radiation are reduced by 25 to 50% if these sulfhydryl compounds are administered before exposure to radiation. Complexing agents are the most effective means for decorporation of ingested or injected radioisotopes, if given immediately following incorporation of the radioisotope. Standards for shielding are discussed. Laboratory methods and materials to minimize incorporation of radioisotopes are outlined. Among these are remote pipetting, rubber gloves, glove boxes, and remotely controlled instruments. Criteria of maximum permissible doses are briefly discussed. The use of whole-body counters and other detection instruments for detection of small amounts of radioisotopes are discussed. (TSS)

26450 CONTRIBUTION TO THE TAMPONADE TECHNIC IN INTRAUTERINE AND INTRAVAGINAL RADIUM DEPOSITION. Spechter, H. J.; Pollack, J. M. (Univ., Tuebingen, Ger.). Z. Geburtsh. Gynaekol., 164: 102-9 (June 1965). (In German).

Prevention of complications is one of the most important problems encountered in Ra treatment of gynecological tumors. By proper use of intravaginal tampons it was possible to prevent summation of dose peaks in the region of the ventral wall of the rectum. A combination of Ra plates and needles was used. Variations in the location of the ureteral pathways were important and exact measurements were difficult. These measurements and those of the γ R dose in the uterus were subject to large errors. The doses were measured at several points in the bladder and the rectum; x-ray photos were made to ascertain the position of the Ra container. The base of the Ra container was shifted to the right in 60% of 168 cases studied. In the cranio-caudal axis the position differed by as much as 9 cm. The dose values measured by dosimeters agreed with x-ray findings. It was shown that with some rigidly placed tampons the container was shifted into a lateral position; dose max could then be measured intravesically. The position of the Ra container was illustrated in photographs. (BBB)

26451 STUDIES ON TELECOBALT THERAPY MEASUREMENTS OF DOSE DISTRIBUTION IN ^{60}Co TELETHERAPY. Okajima, Shonzo (Nagasaki Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 24: 174-9(May 25, 1964). (In Japanese).

Dose distribution in fixed ^{60}Co γ radiation therapy was measured with a scintiscanner mechanism. Many kinds of phantom materials were used, including paraffin, 81% mixed with silicon dioxide, 19%; water; and mixed paraffins. Shapes and sizes of the phantoms included cylinders and ellipsoidal cross section. When the center of rotation coincides with the center of phantom, no practical difference of shape in depth dose curves was seen regardless of materials, size, and shape of phantoms. When the center of radiation shifted from the center to the periphery of the phantom, homogeneity of the beam focus was lost. When field size was 10 × 10 cm and the size of cross section of the phantom was 30 cm in diameter, loss of homogeneity of dose distribution in beam focus occurred in about ±10% per 5 cm shift from the center to the periphery of the phantom. (auth)

26452 PROCEEDINGS OF THE II. SYMPOSIUM ON HEALTH PHYSICS, PECS, HUNGARY, SEPTEMBER 26–30, 1966. VOL. I. Budapest, Publishing Group of the Central Research Institute for Physics, 1966. 227p. (CONF-660948-(Vol.1)).

A total of 39 papers were presented at the symposium. Separate abstracts were prepared for 38. One paper was abstracted previously for NSA; see 21: 12368. (J.R.D.)

For abstracts of individual papers see: 26193–26201, 26250–26258, 26307, 26308, 26453–26467, 26522, 26523, and 27820.

26453 EXPERIMENTAL DETERMINATION OF THE AVERAGE LINEAR ENERGY TRANSFER (LET). Abel, H.; Regel, K.; Rossbach, H.; Eichhorn, K.; Haberer, G. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). pp 23-8 of Proceedings of the Second Symposium on Health Physics. Vol. I. Budapest, Publishing Group of the Central Research Institute for Physics, 1966.

See CONF-660948-(Vol.1).

A method and the experimental equipment for the determination of average LET-values are described. The experimentally determined LET values of x- and γ-radiations are given as a function of the primary quantum energy. Additionally the differences between the average LET values of neutron radiations, when averaged by different methods, are investigated with the aim to clear, what average LET value is appropriate for the use in the QF-LET relation. (auth)

26454 ELABORATION OF NUMERICAL COMPUTER METHODS FOR ANALYZING OF PERSONAL EXPOSURE BY RADIUM γ RADIATION. Lubas, Barbara; Lobodziec, Wlodzimierz (Inst. of Oncology, Gliwice, Poland). pp 69-73 of Proceedings of the Second Symposium on Health Physics. Vol. I. Budapest, Publishing Group of the Central Research Institute for Physics, 1966.

See CONF-660948-(Vol.1).

The numerical computer methods for applying the statistical data of the summarized daily exposure doses for personal exposure analysis based on the specific exposure dose comparison were elaborated. The constructed sets of linear exposure equations have the characteristic conditioning and a combination of the Gaussian elimination method with the least squares method was used. Calculation was carried out by use of the electronic computer URAL-2 according to the program expressed in COPAN-1 autocode. Exemplified analysis was performed for physicians and nurses employed in the Institute of Oncology in Gliwice at gynecological and skin radium applications. (auth)

26455 PERSONNEL FILM MONITORING IN POLAND DURING THE YEARS 1964–1965. Jasiak, J.; Musialowicz, T.; Wysopolski, J. (Central Lab. for Radiological Protection, Warsaw). pp 75-9 of Proceedings of the Second Symposium on Health Physics. Vol. I. Budapest, Publishing Group of the Central Research Institute for Physics, 1966.

See CONF-660948-(Vol.1).

The control organization and results of a systematic monitoring service carried out by the Central Laboratory for Radiological Protection are described. The results are discussed according to statistical principles used by this laboratory. The evaluation of occupational exposure in isotopes laboratories in Poland is given. (auth)

26456 TRITIUM INCORPORATION HAZARD INVOLVED IN THE OPERATION OF NEUTRON GENERATORS. Biro, J. (Central Research Inst. for Physics, Budapest); Feher, I.; Szarvas, T. pp 87-92 of Proceedings of the Second Symposium on Health Physics. Vol. I. Budapest, Publishing Group of the Central Research Institute for Physics, 1966.

See CONF-660948-(Vol.1).

Methods developed for the control of tritium contamination on samples taken from airborne gas and aerosol as well as fallout and wipe tests are described. Investigations performed with these methods in the environment of neutron generators show the tritium incorporation hazard to be most due to the Ti−T or Zr−T particles detached from the target. (auth)

26457 DETERMINATION OF INTERNAL RADIATION DOSES FOR TRITIUM INTAKE. Biro, Tamas; Cziboly, Csaba (National Atomic Energy Commission, Budapest). pp 93-7 of Proceedings of the Second Symposium on Health Physics. Vol. I. Budapest, Publishing Group of the Central Research Institute for Physics, 1966.

See CONF-660948-(Vol.1).

Dosimetric data and control methods for internal tritium contamination are reviewed. Use of urine analysis by liquid scintillation counting for monitoring personnel working in the production and application of labeled compounds is discussed. (auth)

26458 INTERNAL CONTAMINATION MONITORING OF PERSONNEL WORKING WITH ^{14}C LABELED COMPOUNDS. Uchrin, Gy.; Cziboly, Cs.; Golder, F. (National Atomic Energy Commission, Budapest). pp 99-103 of Proceedings of the Second Symposium on Health Physics. Vol. I. Budapest, Publishing Group of the Central Research Institute for Physics, 1966.

See CONF-660948-(Vol.1).

Work in the production and application of ^{14}C-labeled compounds are reviewed. Liquid scintillation methods used for the determination of carbon-14 from exhaled air and urine are described. (auth)

26459 RADIUM D (^{210}Pb) HAZARDS TO URANIUM MINERS. Jaworowski, Zbigniew (Central Lab. for Radiological Protection, Warsaw). pp 117-20 of Proceedings of the Second Symposium on Health Physics. Vol. I. Budapest, Publishing Group of the Central Research Institute for Physics, 1966.

See CONF-660948-(Vol.1).

The sources of contamination with RaD in a uranium mine and the radiation doses obtained from this nuclide by uranium miners are discussed. (auth)

26460 ON THE ^{210}Pb AND ^{210}Po BODY BURDEN OF PERSONS WORKING WITH LEAD. Feher, I.; Molnar, M. (Central Research Inst. for Physics, Budapest. Hungarian Railways' Inst. for Hygiene, Budapest). pp 121-7 of Proceedings of the Second Symposium on Health Physics. Vol. I. Budapest, Publishing Group of the Central Research Institute for Physics, 1966.

See CONF-660948-(Vol.1).

The possible internal exposure to ^{210}Pb and ^{210}Po was studied on persons working in a bearings alloy foundry. It was found that even if the recently marketed, sometimes high specific activity leads are used or in cases of chronic plumbic poisoning the ^{210}Pb and ^{210}Po body burdens of the workers in the foundry do not exceed by any order of magnitude that of the population in general. (auth)

26461 A STUDY OF NATURAL RADIOACTIVE ELEMENTS U^{nat}, ^{226}Ra, ^{210}Po IN THE ORGANS OF INDIVIDUALS WITH NORMAL EXPOSURE. Csoevari, S.; Toth, A.; Zsoldos, T.; Nagy, L. (Hospital of Baranya County, Pecs, Hungary). pp 133-6 of Proceedings of the Second Symposium on Health Physics. Vol. I. Budapest, Publishing Group of the Central Research Institute for Physics, 1966.

See CONF-660948-(Vol. 1).

In order to determine the ^{nat}U, ^{226}Ra, and ^{210}Po content, the organs critical in respect to natural radioelements were analyzed in 9 dead individuals of average exposure. The results can be used as a basis of comparison for evaluating the results obtained in individuals exposed to conditions of uranium-ore mining. (auth)

26462 EXPERIMENTS IN VITRO FOR STUDYING THE DISSOLUTION OF URANIUM- AND RADIUM-CONTAINING AEROSOLS. Csoevari, S.; Toth, A.; Zsoldos, T.; Nagy, L. (Hospital of Baranya County, Pecs, Hungary). pp 137-41 of Proceedings of the Second Symposium on Health Physics. Vol. I. Budapest, Publishing Group of the Central Research Institute for Physics, 1966.

See CONF-660948-(Vol.1).

Experiments were conducted to determine the solubility of aerosols containing natural uranium and ^{226}Ra. In the course of the experiments it was attempted to reproduce conditions similar to those prevailing in the human organism. Solubility experiments made at pH $\approx$ 1/stomach and pH $\approx$ 7/lung were intended to serve as a basis for comparing the results of routine urinalyses to the MPC levels recommended in the literature and given for both water-soluble and water-insoluble compounds. (auth)

26463 WHOLE BODY COUNTING OF ^{90}Sr IN MAN IN PRESENCE OF OTHER NUCLIDES /^{40}K, ^{137}Cs, ^{226}Ra/. Karniewicz, W. (Inst. of Occupational Medicine, Lodz, Poland). pp 143-8 of Proceedings of the Second Symposium on Health Physics. Vol. I. Budapest, Publishing Group of the Central Research Institute for Physics, 1966.

See CONF-660948-(Vol.1).

A method for the whole body counting of ^{90}Sr + ^{90}Y bremsstrahlung was developed. The calibration of the multichannel gamma-ray spectrometer was based upon: measurements of ^{90}Sr + ^{90}Y point sources embedded in plaster of Paris and polymethylmethacrylate, and placed in a phantom of the unit density; or in vivo measurements of humans who received pure ^{90}Y intravenously. In the calibration, contributions from ^{40}K, ^{137}Cs and ^{226}Ra to the low energy range of human gamma-spectra was taken into account. The sensitivity and errors of the method are discussed. (auth)

26464 MEASUREMENTS WITH THE WHOLE-BODY COUNTER OF THE CENTRAL RESEARCH INSTITUTE FOR PHYSICS. Andrasi, A.; Feher, I. (Central Research Inst. for Physics, Budapest). pp 149-56 of Proceedings of the Second Symposium on Health Physics. Vol. I. Budapest, Publishing Group of the Central Research Institute for Physics, 1966.

See CONF-660948-(Vol.1).

The whole-body counter is used for the routine and systematical control of the personnel of the Institute and of the Isotope Institute of the Hungarian AEC and for occasional control of personnel in other institutions. The technical data of the assembly, the characteristic parameters, and the calibration procedure are briefly described. Measurements on persons with incorporated ^{65}Zn, ^{226}Ra, and ^{192}Ir isotopes and the inferences that can be made from the results are discussed. Data are presented on the ^{137}Cs body burden of the population in Hungary observed from measurements over the period from 1964 to 1966. (auth)

26465 INTERNAL EXPOSURE HAZARDS EVALUATION FROM ACTIVATED CORROSION PRODUCTS. Fojtik, M.; Koprda, V. (Research Inst. of Industrial Hygiene and Occupational Diseases, Bratislava). pp 189-93 of Proceedings of the Second Symposium on Health Physics. Vol. I. Budapest, Publishing Group of the Central Research Institute for Physics, 1966.

See CONF-660948-(Vol.1).

The origin of activated corrosion products from constructive materials of primary coolant circuit in a nuclear power plant is discussed. The relative activities of corrosion products were calculated and the radiobiological hazards were evaluated from the ICPR recommendations. For the purpose of separation of long-lived group of corrosion products, an anion exchange chromatographic temperated column was employed. The separation method was verified by the analysis of biological material. (auth)

26466 IRRADIATION FACILITIES FOR GAMMA AND NEUTRON DOSE CALIBRATION. Makra, S.; Bekes, E.; Meszaros, I. (Central Research Inst. for Physics, Budapest). pp 199-204 of Proceedings of the Second Symposium on Health Physics. Vol. I. Budapest, Publishing Group of the Central Research Institute for Physics, 1966.

See CONF-660948-(Vol.1).

Calibration sources for gamma and neutron radiation and calibration techniques are discussed. For gamma calibration various γ sources and x-ray machines are used. The irradiation of the instruments to be calibrated are performed in an electro-pneumatically controlled facility built to ensure safe operational conditions. For neutron calibration PoBe, PuBe, paraffin spheres covered PuBe, and photoneutron sources are available. (auth)

26467 RADIATION PROTECTION PROBLEMS CAUSED BY DEFECTS IN SEALED SOURCES. Jackisch, N. (Radiation Protection Center of the GDR, Berlin). pp 205-9 of Proceedings of the Second Symposium on Health Physics. Vol. I. Budapest, Publishing Group of the Central Research Institute for Physics, 1966.

See CONF-660948-(Vol.1).

Radiation accidents in industry and medicine, caused by defects in sealed sources, are described. Personnel contamination and incorporation were measured, results of excretion analysis and whole-body counting are given. Provisions made to prevent similar accidents are represented. (auth)

26468 PROBLEMS OF ATOMIC ENERGY. MOUNTAINS OR MOLEHILLS. McCullough, C. Rogers. 33p. (CONF-660621-25). DTIE. Gmelin, AED-CONF-66-193-30.

From Health Physics Society, 11th Annual Meeting, Houston, Tex.

It is generally recognized that the effects of different kinds of radiation must be related to each other by a Relative Biological Effectiveness (RBE) factor to be at least approximately comparable. The immediate effects of relatively large doses delivered in a short time are known within a factor of about two. Spreading the dose over a period of time reduces the immediate effect. As the individual doses become less, the effects seem to decrease.

Delayed effects, if any, usually are indistinguishable from those induced by other causes. There is apparently a mechanism of repair or alleviation of effect. This may even extend to genetic effects. It is not at all certain that dose effects can be extrapolated linearly all the way to zero. A decreasing effect with lower doses can act, effectively, as a threshold. There is even the possibility of finding that low levels of radiation, such as background, can have over-all beneficial results. The setting of permissible doses for radiation workers has been based on the requirement of no detectable damage and a balancing of risk against the need to do a job. The recommendations relating to the general public have been equally conservative. The protection of the public against major accidents, particularly in large reactors, has created an effective multiple stage review system. The rapid growth of the nuclear industry, and especially the rapid increase in power of the reactors, poses special problems. (H.L.W.)

26469 IMPROVEMENTS RELATING TO NOVEL TEXTILE PRODUCTS. (to Daido Keori Kabushiki Kaisha). British Patent 1,059,353. Feb. 22, 1967. Priority date Aug. 7, 1962, Japan.

A textile product is described that is designed to give protection from radioactivity, particularly radioactive fallout. The textile consists of a fibrous material impregnated with high-molecular-weight products formed by curing a synthetic resin in the presence of an organic amino carboxylic acid, or a Na, K, NH_4^+, Al, Ba, or Ca salt of this acid and water. (B.L.M.)

Medicine

Refer also to abstracts 26236, 26242, 26339, 26351, 26414, 26437, 26450, 26451, 26558, 26565, 26601, 26627, 26628, 26648, and 26656–26659.

26470 (BNL–50029) MEDICAL SURVEY OF THE PEOPLE OF RONGELAP AND UTIRIK ISLANDS ELEVEN AND TWELVE YEARS AFTER EXPOSURE TO FALLOUT RADIATION (MARCH 1965 AND MARCH 1966). Conard, Robert A.; Meyer, Leo M.; Sutow, Wataru W.; (and others) (Brookhaven National Lab., Upton, N. Y.). Apr. 1967. 170p. Dep. CFSTI.

The Rongelap people were in good health with satisfactory nutritional status. No unusual epidemics of disease occurred. The death rate was higher in the exposed population than in the unexposed population, which may be related to the larger percentage of older people originally in the exposed group. Birthrate was about equal in the exposed and unexposed groups. The people of Utirik Island appeared to be in good health, and the birth and death rates in this group appeared to be similar to those in the Rongelap group. With the exception of thyroid disorders, physical abnormalities did not appear to be significantly different in the exposed people as compared with the unexposed population. The trends toward growth retardation in the exposed children continued. No leukemia or cancer was detected. The dosimetric calculation for radiation dose to the thyroid from internal absorption of radioactive iodine from fallout was reviewed. Early thyroid studies including protein-bound iodine determinations, iodoprotein levels, dietary iodine and urinary excretion of iodine, thyroid uptake of radioiodine, and serum cholesterol levels were reviewed. Thyroid abnormalities during the past 3 years increased to 18 cases. Surgery was performed in 11 cases; 9 children and 1 adult were found to have adenomatous goiters, and one adult a carcinoma of the thyroid gland with localized metastasis. The gross and microscopic appearance of these lesions was described and depicted. Correlation of growth retardation in exposed children with thyroid pathology was observed. Thyroid function tests in cases with thyroid abnormalities also indicated reduced thyroid function in some other children. Preliminary indications are that thyroid hormone treatment is having a beneficial effect. Hematological studies show that the leukocyte and platelet levels of the peripheral blood of the exposed people seemed to have recovered to levels equal to those of the unexposed population. Chromosome studies of white cells of 51 peripheral blood cultures showed a low incidence of 2-hit aberrations in the exposed people which was quite significant in view of the absence of any such aberrations in the comparison population. Aging studies were repeated with the addition of several new parameters, vibratory sense, light extinction test, body potassium levels, and blood serum cholesterol, and with more refined statistical analysis. Curves of response for each aging parameter and an over-all biological age score curve are presented. Internal body burdens of radionuclides were estimated using a NaI (Tl) crystal in a portable shadow-shield type of counter. The Rongelap residents exposed in 1954 and the unexposed residents were indistinguishable by this method, both groups showing elevated ^{137}Cs and ^{60}Co body burdens. Urine specimens were also analyzed radiochemically for ^{90}Sr and ^{137}Cs. (TSS)

26471 (NYO–3267–4) THERMAL AND EPITHERMAL NEUTRONS IN THE TREATMENT OF NEOPLASMS. Technical Progress Report, June 1, 1966–April 30, 1967. Sweet, William H. (Massachusetts General Hospital, Boston). Apr. 26, 1967. Contract AT(30-1)-3267. 24p. Dep. CFSTI.

Progress is reported on investigations of the use of thermal and epithermal neutrons for the treatment of neoplasms. Preliminary studies indicated the compound $B_{12}H_{11}SH$ shows promise for use for neutron capture therapy and attempts to synthesize derivatives and evaluate their biological properties are reported. Miscellaneous boron compounds were screened for their usefulness for neutron capture therapy. A chemically-induced intracranial neoplasm was developed that grew when transplanted in new-born rats and in tissue culture. The potential usefulness of steroid hormones in preventing radiation injury of the cerebrovascular endothelium during boron–neutron capture irradiation was evaluated in cats. Cats pretreated with steroids showed minimal changes in the central nervous system after neutron capture irradiation. Evidence is presented that brain protein fraction 10B is quantitatively increased in glial tumors when compared to normal brain. These findings are of interest in an attempt to isolate brain tumor proteins for the preparation of antisera that will localize preferentially in brain tumor cells. A list is included of 18 publications during the period covered by this report. (C.H.)

26472 THE CYTOLOGICAL ASPECTS OF RADIOPROTECTION MECHANISMS OF SEROTONIN ON THE TUMOR, BONE MARROW, AND THYMUS CELLS. Yoshizaki, Tsutae (Tokushima Univ., Japan). Shikoku Igaku Zasshi, 22: No. 1, 126-35 (Feb. 1966). (In Japanese).

The purpose of this study was to demonstrate the effects of Serotonin on the cell multiplication of tumor, bone marrow, and thymus cells. The mitotic rate of the treated Ehrlich and MTK-III tumor cells became relatively high in 1 to 9 hours after administration. The frequency of prophasic cells increased markedly at 1 hour and with a remarkable increase of metaphasic cells at 6 hours after the administration. The mitotic frequency of bone marrow cells after the treatment showed a similarly increase to that of the tumor cells. A long time overshoot above normal mitotic rate of thymus cells occurred during 1 to 9 hours after Serotonin treatment. Prophasic cells strongly increased in 1 to 3 hours and metaphasic cells increased at 6 hours after administration. The effects of Serotonin on resting nuclei appeared as follow; heterochromatic coagulation, abnormal distribution of chromatin, and rounded shape of nucleolus in all materials during 3 hours after the administration. (NSA of Japan)

26473 DEVELOPMENT OF TELECOBALTTHERAPY UNIT WITH A NEW COLLIMATION DEVICE FOR CONFORMATION RADIOTHERAPY. A STUDY ON CONFORMATION RADIOTHERAPY. XVI. INVESTIGATION OF HIGH-VOLTAGE GAMMA-RAY IRRADIATION METHODS. Kitabatake, Takashi (Aichi Cancer Center, Japan); Makino, Sumio. Igaku Hoshasen Gakkai Zasshi, 26: 192-200(May 1966). (In Japanese).

A new collimation device for use in a ^{60}Co teletherapy unit was developed for conformation therapy. Mechanisms of this new collimation device consisted of 18 blades of diaphragm; cam mechanism; synchronizing rotation system including synchro-oscillator, beam focus radiographic apparatus, and cam profiling machine. By using this unit, all kinds of conformation therapy such as irregularly moving field technique, hollow-out irradiation method and partial shielding moving technique could be practiced. Treatment planning, procedures, and isodose distribution are discussed. (auth)

26474 THE EFFECT OF RUBY LASER RADIATION ON THE CLOUDMAN S-91 MELANOMA IN THE CDBA/$2F_1$ HYBRID MOUSE. Minton, John Peter; Ketcham, Alfred S. (National Cancer Inst., Bethesda, Md.). Cancer, 17: 1305-9(Oct. 1964).

The use of ruby laser radiation (6943 Å) for permanent destruction of melanoma implants in hybrid mice was studied. The effect of laser radiation was limited to a designated target area. Permanent tumor destruction appeared to be related to the amount of laser energy delivered to the tumor and to the size of the tumor implant. Some tumors that burst open were noted to have taut skin over their surface. Rupture of skin over these tumors was postulated to be from pressure created by the expansion of vapors that originated from evaporation of tissue following laser beam impact. Large tumors that did not burst open were noted to lose skin covering. Incomplete destruction of tumors had no effect on survival of the tumor-bearing animals. The data obtained indicated that a relation exists between tumor size and laser energy for permanent destruction of tumors. (TSS)

26475 NONSURGICAL TREATMENT OF PULMONARY NEOPLASM. Shnider, Bruce I. (District of Columbia General

Hospital, Washington, D. C.); Zevallos, Prospero. Med. Ann. Dist. Columbia, 35: 528-30(Oct. 1966).

Studies are reviewed that pertain to the possible synergistic action of ionizing radiation on chemotherapy in lung cancer treatment. Neither nitrogen mustard nor triethylenethiophosphorimide treatments were effective in previously irradiated lung carcinoma. In tumors not previously irradiated, one-third showed a decrease in tumor size without improvement in survival time. In an evaluation of nitrogen mustard, x-ray therapy (4000 rad), and nitrogen mustard plus x-ray therapy (4000 rad), increased toxicity was demonstrated with combination therapy, and survival was not influenced. When the x-ray dose was increased to 5000 rad and randomized against a combination of x-rays and 5-fluorouracil or x-rays and actinomycin D, no improvement in survival time could be demonstrated. It is suggested that large doses of x rays may have prevented demonstration of the ability of chemotherapeutic drugs to sensitize tumors to ionizing irradiation. (TSS)

26476 RADIONUCLIDE IMAGING TECHNIQUES IN THE DETECTION OF CANCER. **Haynie, Thomas P. (Univ. of Texas, Houston). Cancer, 20: 607-13(May 1967).**

Radionuclide imaging is the display of organs and tumors by the selective concentration of radioactive materials. The most popular method for making these studies during the past five years has employed a variety of radiopharmaceuticals and the photoscanner. Techniques have been developed for scanning tumors of the brain, thyroid, lung, liver, kidney, pancreas, spleen, bone, and parathyroid. Recent advances in instrumentation include colorscanning and the development of stationary scanning devices called gamma cameras. Short-lived radionuclides also are coming into increasing use, substantially increasing the speed with which the procedures can be performed and reducing the radiation exposure to the patient. These improvements should make these procedures even more useful in the future. (auth)

26477 PITUITARY ABLATION WITH ^{90}Y IMPLANT IN ADVANCED THYROID CANCER. **Bucalossi, Pietro; Veronesi, Umberto; Cascinelli, Natale; Buraggi, Gian Luigi; Miserocchi, Enrico; Monfardini, Silvio (National Cancer Inst., Milan. Univ., Milan). Cancer, 20: 724-6(May 1967).**

To suppress TSH secretion, hypophysectomy was carried out in 14 patients with advanced thyroid cancer. Considered as candidate to hypophysectomy were patients with either locally advanced inoperable disease or distant metastases. Positive results were obtained in six cases: In five objective regression was observed; the last one showed an arrest of growth lasting 2½ years. Five of the six responsible cases were differentiated carcinomas and one was undifferentiated. The best result was obtained in a patient with signs of cretinism, whose cancer developed in a large goiter dating from infancy. (auth)

26478 EARLY DETECTION OF BONE LESIONS BY PHOTOSCANNING WITH RADIOACTIVE STRONTIUM. **Sklaroff, David M.; Charkes, N. David (Albert Einstein Medical Center, Philadelphia). Cancer, 20: 734-7(May 1967).**

Calcium has been shown to accumulate in areas of bone metastasis in amounts greater than in normal bone even prior to observable roentgenographic changes. There is no suitable isotope of calcium which can be utilized easily in the average hospital isotope laboratory for external counting but isotopes of strontium can be substituted for calcium and their distribution in areas of active osteogenesis readily visualized by photoscanning. This technique has been used in the examination of more than 500 patients and in many cases early lesions of bone have been demonstrated prior to observable roentgenographic changes. (auth)

26479 TREATMENT OF INOPERABLE CANCER OF THE LIVER BY INTRA-ARTERIAL RADIOACTIVE ISOTOPES AND CHEMOTHERAPY. **Ariel, Irving M.; Pack, George T. (Pack Medical Foundation, Inc., New York. Hospital for Joint Diseases, New York). Cancer, 20: 793-804(May 1967).**

One hundred eighteen patients were treated. Of 22 patients given cancer chemotherapeutic drugs alone (methotrexate and 5-FU), 27% showed objective responses and 59% subjective responses; the average duration of life was 3.9 months. Of 37 patients treated with radioactive isotopes alone (^{90}Y radiating microspheres), objective responses were observed in 32% and subjective responses in 54%; the average duration of life was 4.6 months; 4 patients still are alive at 4 to 18 months. Of 59 patients treated by a combination of cancer chemotherapy and ^{90}Y microspheres, 47% showed objective responses and 61% subjective responses; the average duration of life was 5.6 months and 4 patients still are alive at 5 to 36 months. In the selection of suitable patients for treatment, hepatic gammascanning has been useful, particularly the combined scans utilizing ^{131}iodine rose bengal and ^{198}gold, for determining the gross anatomic extent of cancerous hepatic involvement and the status of the noninvolved hepatic parenchyma. (auth)

26480 MEGAVOLTAGE RADIOTHERAPY IN HYPERBARIC OXYGEN. A CONTROLLED TRIAL. **Cade, I. S.; McEwen, J. B. (St. Mary's Hospital, Portsmouth, Eng.). Cancer, 20: 817-21(May 1967).**

A controlled trial of megavoltage radiotherapy in hyperbaric oxygen in the management of carcinoma of the bronchus and bladder has been in progress since January 1964. A dose of 6000 R is given with a ^{60}Cobalt unit using daily fractionation for eight weeks, either in air or hyperbaric oxygen at 3 atm pressure, on a basis of random selection. A preliminary review is given of the results in the first 89 patients in the trial, with a minimum follow-up period of six months. The response in 51 additional patients, treated for other conditions by megavoltage radiotherapy in hyperbaric oxygen outside the trial, is discussed briefly. In all, 2363 treatments have been given in hyperbaric oxygen to these two groups of patients. The results, although not yet conclusive, are disappointing and the possibility of increasing the rate of growth of metastases by hyperbaric oxygenation is raised. (auth)

26481 STUDIES OF CHEMICAL SENSITIZATION IN THE RADIOTHERAPY OF ORAL AND CERVICAL CARCINOMAS. **Krishnamurthi, S.; Shanta, V.; Nair, M. Krishnan (Cancer Inst., Madras). Cancer, 20: 822-5(May 1967).**

The primary treatment for carcinomas of the oral cavity and the uterine cervix at the Cancer Institute in Madras, India, is radiotherapy followed by radical surgery if and to the extent necessary. Following radiation alone, the five-year disease-free survival rate of patients with oral cancer is only 29%; with cervix cancer it is 42%. Post-irradiation surgery is indicated wherever possible, but the serious morbidities involved in the surgery led us to try the method of chemical sensitization to radiotherapy. In buccal carcinomas, Synkavit and in the cervix, S.P.I., were used as sensitizers. Standard lesions (whole-cheek fibrotic carcinomas and stage III cervical carcinomas) were used in the trial. Concurrently cases were randomized into control and study groups closely comparable biologically and clinically. The sensitizers were administered according to a special protocol and results assessed by the "triple blind" technique. The techniques of radiotherapy employed were standardized for the cancer at each site. The primary healing rate and the survival rate were selected to be the criteria of response. Studied were 145 cases with buccal carcinomas and 137 cases with stage III cervical carcinomas. Differential response was highly significant in favor of the sensitized cases, $P < 0.02$ for buccal carcinomas and $P = 0.0005$ for cervical carcinomas. (auth)

26482 ^{131}I-LABELED ANTIBODIES TO HUMAN FIBRINOGEN. DIAGNOSTIC STUDIES AND THERAPEUTIC TRIALS. **Spar, Irving L.; Bale, William F.; Marrack, David; Dewey, William C.; McCardle, Robert J.; Harper, Paul V. (Univ. of Rochester, N. Y. Anderson Hospital and Tumor Inst., Houston, Tex. Univ. of Chicago). Cancer, 20: 865-70(May 1967).**

Homologous ^{131}I fibrinogen and its purified antibody will concentrate in a major portion of the neoplasms of the dogs and humans into which they are injected, according to new data. This report gives the scintillation scanning results obtained after IV administration of ^{131}I-labeled and purified antihuman fibrinogen to 172 consecutive patients with various types of neoplasms. In 75% (129/172) of the cases the tumor, in various sites, was unequivocally located. These included mammary carcinomas (12/17), malignant melanoma (16/26), bronchogenic carcinoma (27/34), osteogenic sarcomas (9/9), hypernephromas (6/6), and primary tumors of the brain (10/18). The ^{131}I deposition in tumor relative to normal tissue and blood was so great that in 12 terminal patients therapeutic trials were initiated using 100 to 160 mc of the labeled antibody preparation. In some of these attempts, there was substantial remission of clinical symptoms. The usefulness of this technique for specific radiation therapy of tumors will be greatly improved when methods are developed for increasing ^{131}I concentration in the neoplasm. Several approaches, including fever, endotoxin, pretreatment with fibrinolytic agents and post-treatment with antifibrinolytic agents, are under intensive investigation in experiments and offer great promise. (auth)

26483 URINARY FINDINGS OF CHILDREN WHO WERE IN UTERO DURING THE ATOMIC BOMBINGS OF HIROSHIMA AND NAGASAKI. **Freedman, Lawrence R.; Keehn, Robert J. (Atomic Bomb Casualty Commission, Hiroshima. Atomic Bomb Casualty Commission, Nagasaki). Yale J. Biol. Med., 39: 196-206(Dec. 1966).**

Data from urinalyses at ages 9 to 16 were tabulated for children exposed to ionizing radiation in utero at the time of the atomic bombings in Hiroshima and Nagasaki in 1945 and for comparable control groups. Proteinuria was detected more often at various ages in boys in Hiroshima and girls in both cities whose mothers were within 1,500 meters of the bomb hypocenters than in any other distance grouping. The differences were statistically significant in girls at ages 13 and 14. Future investigations were deemed necessary before the biological significance of these findings could be defined. (auth)

26484 ONCOLYSIS WITH LASER ENERGY COMBINED WITH CHEMOTHERAPY. **Minton, John Peter; Weiss, George H.; Zelen, Marvin (National Cancer Inst., Bethesda, Md.). Nature, 207: 140-1(July 10, 1965).**

The results of experiments comparing the effect of laser radiation and the effects of laser radiation combined with cyclophosphamide chemotherapy on tumors of mice are presented. Results showed that permanent tumor destruction by laser energy was significantly increased when mice received cyclophosphamide. Six-week-old CDF$_1$ female mice were injected with Cloudman S91 melanoma. After two weeks the mice received an 11-day course of subcutaneous cyclophosphamide injections (25 mg/kg/day). At the end of the fifth or sixth day of chemotherapy, some tumors were treated with ruby laser energy. Out of 15 pairs treated, 14 showed tumor destruction by the combination of laser and chemotherapy; tumor recurrence occurred in the paired mice that received laser radiation treatments. The effect of chemotherapy before irradiation by laser energy was a decrease in growth rate of the tumor. Consequently at the time of laser radiation, the animals receiving chemotherapy had tumors that were slightly smaller than those that did not receive chemotherapy. Tumors that recurred after laser radiation appeared to grow at a much faster rate than before irradiation. In contrast, recurrent tumors after combination chemotherapy and radiotherapy had a reduced growth rate. (TSS)

26485 THE RADIOSENSITIVITY OF ESCHERICHIA COLI B CULTURES. III. PRE- AND POST-IRRADIATION EFFECT OF COMPOUNDS OF THE CYSTEINE AND CYSTEAMINE TYPE. Nagy, Zs.; Hernadi, F.; Kovacs, P.; Bekesi, I. (Medical Univ., Debrecen). Acta Biol., Hung. Acad. Sci., 17: 223-31(1966).

The protective effect afforded by cysteine, cysteamine, and penicillamine against the lethal effect of x radiation on E. coli B cell suspensions was examined. It was demonstrated that the effects of these compounds are time- and temperature-dependent and possess a pre- and postirradiation effect. This protective effect was significantly increased if the bacterial suspension was incubated for 30 min at 37°C prior to irradiation in the presence of the compounds; the incubation of cysteamine lasted 15 min and that of cysteine and penicillamine, 30 min. The radioprotective effect was also achieved by incubating irradiated cell suspensions for 30 min before plating. The results indicated that the protective effect on E. coli B of these compounds involved both physicochemical and metabolic features. It appeared, moreover, that the compounds were able to increase the rate of survival of the damaged cells by means of influencing the so-called methionic reaction that takes place after irradiation; that is, the compounds were bound to target molecules via disulfide bonds and exerted the protective action. (BBB)

26486 IN UTERO EXPOSURE TO THE HIROSHIMA ATOMIC BOMB: AN EVALUATION OF HEAD SIZE AND MENTAL RETARDATION TWENTY YEARS LATER. Wood, James W.; Johnson, Kenneth G.; Omori, Yoshiaki (Atomic Bomb Casualty Commission, Hiroshima). Pediatrics, 39: 385-92(Mar. 1967). (ABCC-9-65).

Follow-up examinations were made on the basis of an earlier study made by Miller in 1954 of children who were in utero and within 2200 m from the hypocenter at the time of the atomic bombing in Hiroshima. These earlier observations were, with few exceptions validated, by this follow-up of the subjects at 20 yr of age, and the value and accuracy of clinical evaluation in early childhood were confirmed. Both small head size circumference minus two standard deviations or more and mental retardation were most closely related to maternal exposure within 1500 m from the hypocenter and to a gestational age of less than 15 weeks. The heads of infants with either small or normal circumferences at birth increased thereafter in circumferences at the same rate and stopped growing at the same age, thereby maintaining the same size relation throughout childhood into adult life. Mortality in the mentally retarded group as a whole exceeded mortality in normal children. For the group of all subjects exposed within 1500 m the mortality rate was higher than for the subjects located beyond 1500 m. (BBB)

26487 CLINICAL CORRELATION OF ISOTOPE PANCREATOGRAPHY. Sodee, D. Bruce (Doctors Hospital, Cleveland). Amer. J. Gastroenterol., 45: 454-9(June 1966).

Clinical results are correlated with animal data in the development of pancreatic scanning utilizing selenomethionine-^{75}Se. Clinical investigative data collected on 101 patients who underwent the complete pancreatic scan series are reported. A scanner with 5 × 2 in. crystal and a 5-in. broad focus collimator was utilized for all pancreatic scans. Selenomethionine-^{75}Se, 3.5 μCi/Kg body weight, was injected intravenously prior to scanning. In the early part of the study scans were begun 30 min postdose. In light of animal data, however, this was changed to 1 to 2 hr postdose. Liver scans with ^{198}Au were performed on all patients before the pancreatic scan series to determine exactly where the liver edge was to locate better the pancreatic bed. An important factor in interpreting the scans was the maximum cpm value found over the pancreatic head. The normal pancreas had counts about 2500 cpm when focused on the head. All patients with proven pancreatitis had count rates below 2000 cpm. Although a protein meal did not increase the amount of selenomethionine in the pancreas, it did enhance the clearance of this isotope from the blood. Therefore, the protein meal was used in the pancreatic scan series. The pancreatic scan was also an aid in leading to the diagnosis of pancreatic carcinoma. Six of 10 patients with proven pancreatic carcinoma had abnormal pancreatic scans. The enlarged and deformed pancreas indicates pancreatic carcinoma by scan. The radiation dosimetry of this procedure was established in animals and corroborated in the human. The whole-body and the gonadal radiation dose is ~2 rad. Since pancreatic carcinoma and most pancreatic diseases are found in patients over 40 yr of age, this amount of irradiation presents no problem. (BBB)

26488 MAXILLARY APPLIANCE FOR CONTROLLED RADIUM NEEDLE PLACEMENT. **Rudd, Kenneth D.; Pedersen, Robert E.; Morrow, Robert M.; Green, Allen E. Jr. (Wilford Hall USAF Hospital, Lackland Air Force Base, Tex.). J. Prosth. Dent., 16: 782-7(July-Aug. 1966).**

Construction of a dental prosthesis for Ra irradiation of a palatal tumor is described, illustrating features of radioprotection. It was planned to give a dose of 7300 R over an 8-day period to the lesion. (BBB)

26489 ^{90}Sr-APPLICATOR FOR INTERSTITIAL IRRADIATION OF HYPOPHYSIC. Holmer, A. (Aktiebolaget Atomenergi, Studsvik, Sweden); Baerring, N. E.; Melander, O.; Notter, G.; Widell, C. O. Fortschr. Geb. Roentgenstr. Nuklearmed., 106: 574-8 (Apr. 1967). (In German).

The indications and advantages of the interstitial irradiation of the pituitary with ^{90}Sr applicators are discussed in comparison with the insertion of radioactive cylinders and spheres. A description is given of the design of ^{90}Sr applicators and of the dose distribution around a set of two applicators; the dimensions of these applicators are 1 mm outer diameter, length 4.5 mm. The technique for their clinical application is described. So far five patients have been treated. (auth)

26490 CURRENT STUDIES WITH AET AND SEROTONIN FOR PROTECTION AGAINST PARTICULATE RADIATION INJURY. Meredith, O. M.; Bowers, E. G.; Coleman, E. J. (Lockheed Missiles and Space Co., Palo Alto, Calif.). Proc. West. Pharmacol. Soc., 8: 64-6(1965).

Combinations of the established radioprotective agents AET and serotonin were tested against deleterious effects of 1-MeV electron radiation. This is an extension of data reported previously in which neither one of these agents was effective alone in reducing the degree of injury inflicted by 1-MeV electrons. The radiation exposures were administered at the LD$_{99(30)}$ level: 1000 rad for the ventral aspect or 1500 rad for the dorsal aspect. The dose rate was 3000 rad/minute. Attenuation of the lethality response occurred when only the ventral abdomen and hindquarters were exposed. A severe lethal effect occurred whether all or part of the ventral surface was exposed when the protective agents had not been administered. On the contrary, a maximally lethal effect was noted only when the entire dorsal surface was affected. These results are surprising since the abdominal region has been found to be most responsive to irradiation. These data show a protection by chemical agents when the intestinal mass is receiving a significant radiation exposure while much of the bone marrow is shielded. In other terms, AET plus serotonin moderate only the intensity of the intestinal injury. (BBB)

26491 ON THE SUBJECT OF THE PROTECTIVE ACTION OF CYSTEAMINE AND CYSTAMINE IN RATS HAVING RECEIVED LETHAL DOSES OF MYLERAN. **Dunjic, A. (Univ., Louvain, Belg.). Pathol. Biol., Semaine Hop., 14: 554-8(May 1966). (In French).**

Certain effects of radiomimetic drugs, just as the effects of ionizing radiations, can be prevented by pretreatment with radioprotective agents. The inhibitory effects of two such protective agents were experimentally tested using Myleran, a drug widely used in cancer therapy; results were compared with protection afforded against x rays. Cystamine and cysteamine reduced the lethal action of Myleran in rats. After intraperitoneal administration of 69 mg/kg of cysteamine or cystamine 1 hr after the oral ingestion of lethal doses of Myleran, the reduction factor of the dose of Myleran was 1.34 and 1.35 respectively. If 690 mg/kg of cysteamine was given orally 1 hr before the lethal dose of

Myleran, which was also given orally, the reduction factor increased to 3.43. In the latter case, it was suggested that this was due to chemical competition between cystamine and Myleran in the gastrointestinal tract. The dose reduction with Myleran was greater than that for x radiation. When 69-mg/kg doses of cystamine and cysteamine were followed by x irradiation, the dose reduction factors were 1.26 and 1.21. (BBB)

26492 PLASTIC SURGERY IN MALIGNANT TUMORS. **Schedel, Franz (Staedtische Krankenhaus, Passau, Ger.). Chirurg, 36: 109-13(Mar. 1965). (In German).**

Very close cooperation between surgeon and radiologist is needed if x-ray treatment of healing tissue is required following plastic surgery after removal of malignant tumors. X irradiation should be used to prevent metastases. Experience indicates that blood circulation is improved and skin healing is faster after telecobalt irradiation. Tissues irradiated prior to transplantation provide better sites for transplantation. Biopsy procedures should be carried out after preirradiation, even though the area operated on may be hyperemic. However, the advantage of a more sure diagnosis outweighs this disadvantage. (BBB)

26493 LYMPHOGRAPHIC CHANGES CAUSED BY RADIOTHERAPY. **Wiljasalo, M.; Perttala, Y. (Univ., Helsinki). Ann. Med. Inter. Fenn., 55: 57-60(1966).**

The effect of radiation therapy upon lymph nodes and lymph vessels was studied in 87 patients who were subjected to lymphography. This procedure in some patients was performed immediately, in others after 3 months, and in most cases 1 yr after treatment. The radiation dose used was 4000 to 6500 R. In 7 out of 77 patients impairment of lymph flow was caused exclusively by radiation therapy and in 10 it was evoked by surgical treatment combined with irradiation. The effect of irradiation on the lymph glands was not detectable in the lymphogram until 6 months later. The periglandular vessels were distended. The valvular system was not perceptible and the vessel gave a fibrotically inflexible impression. The lymph nodes tended to be totally destroyed 1 yr after treatment with doses of about 6000 to 8000 R, but the gland and surrounding area appeared in most cases to be fairly normal, though somewhat smaller than usual. Upon destruction of the regional lymph glands the peripheral parts, with tapering vessels, showed tortuosities and presented a typical picture of lymph edema. Distinct collateral formation appeared in the irradiated area. Local irradiation of the skin produced local edema, detectable in the lymphogram. (BBB)

26494 LOCAL DAMAGE FOLLOWING RADIOTHERAPY. **Yamashita, Hisao; Yoshioka, Tatsuo (Keio Univ., Tokyo). Jibi Inko-ka, 37: 931-6(Oct. 1965). (In Japanese).**

Radioinduced skin injuries are reviewed, with reference to the authors' own observations. Following radiotherapy an acute reaction may occur within one week after one or several doses. Less than 300 R will cause alopecia, 400 to 500 R will cause erythema, 500 to 700 R will result in erosion, and above 700 R ulceration. Subacute reactions will occur following 3000 R or more accumulated dose 2 weeks to 2 months following irradiation. The stages of radioinduced changes are from epidermitis sicca to epidermitis exsudativa to ulceration as the dose increases from 3000−5000 R, to 5000−7000 R, and to 7000 R and above. Chronic reactions may develop up to 10 yr or more. In the first stage, atrophy of the epidermis is noted with pigmentation and vasodilatation; in the 2nd stage, cornification results in hypertrophy of epidermis; in the 3rd stage, ulceration appears with deepithelization; in the 4th stage, cancerous changes may appear. Supravoltage radiotherapy can lower the radiation exposure on the skin to the extent of reducing the change to epidermitis sicca, but it may lead to fibrosarcomatous changes. Abnormal cornification and chronic ulceration should be treated surgically. Mucosal changes may include acute or subacute radioepithelite. Mucus secretions may decrease and taste and olfactory senses may be lost. In the authors' series, 63 out of 300 cases of skin cancer were subsequent to irradiation. These were chiefly due to 14 cases of head and neck cancers and to radiotherapy for eczema, dermatoses, tuberculous lymphadenitis, and hemangioma. Treatment had been given in 100 to 150 R weekly doses for half a year to 10 years up to total dosage of 5500 to 8500 R. The latent period was from 10 to 35 yr for squamous cell carcinoma. Laryngeal and thyroid cancers following irradiation of lymphadenitis and hemangioma were seen in 40- to 60-yr-old patients. (BBB)

26495 RADIOACTIVE PHOSPHORUS AS AN AID TO THE DIAGNOSIS OF PIGMENTED SKIN LESIONS. **Pearson, D.; Duthie, M. B.; MacKenzie, L. A.; McHugh, M. J. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Clin. Radiol., 18: 188-92(Apr. 1967).**

An attempt was made to differentiate between pigmented benign and malignant skin lesions using a tracer dose of radioactive phosphorus. The ratio of the uptake in the lesion to the uptake in normal skin, L/N, one hour after the intravenous injection of ^{32}P is considered to be the best criterion for diagnosis. The results in 222 patients with suspected malignant melanomas are analysed against the histology obtained later at operation. When a low L/N ratio (<1.2) is obtained from this test it is highly probable that the lesion is benign, only one out of 115 malignant tumors in this series giving a low result. High L/N ratios (>1.8) may be caused by infection and by sclerosing angiomas as well as by malignancy; and a substantial minority of results will come within the indeterminate range (1.2−1.8). The main value of this investigation may therefore be in the indication of likely non-malignancy in a suspicious lesion before biopsy or excision. (auth)

26496 RADIOLOGICAL EXOPHTHALMOMETRY. **Bogren, Hugo; Tengroth, Bjoern (Univ. of Goteborg). Clin. Radiol., 18: 193-6(Apr. 1967).**

A new exophthalmometer is described in which a combination of a radiograph and a photograph is used. The new method was compared with that of Hertel. It has three to four times the sensitivity of Hertel's and can also be used to detect absolute exophthalmos. In 41 patients with exophthalmos determined by the new exophthalmometer, only 60% would have been diagnosed if Hertel's method alone had been used. (auth)

26497 LIMITATIONS OF LATERAL PELVIMETRY. **Rubin, E. L.; Francis, H. (Liverpool Maternity Hospital). Clin. Radiol., 18: 213-17(Apr. 1967).**

Owing to the radiation hazard, curtailment of radiography in obstetrics must be accepted. Clinical assessment of the pelvis does not always compensate for this restriction. Some limitations of lateral pelvimetry are described. A normal or near-normal lateral radiograph may mask a gross pelvic deformity with severe asymmetry. (auth)

26498 IRRADIATION OF THE NASOPHARYNX IN CHILDREN: A SURVEY OF PATIENTS 5–20 YEARS AFTER TREATMENT FOR LYMPHOID HYPERPLASIA. **Manning, Miriam D.; D'Angio, Giulio J. (Children's Cancer Research Foundation, Boston. Harvard Univ., Boston). Clin. Radiol., 18: 173-5(Apr. 1967).**

Questionnaires were sent to the parents of 890 patients, age 0 to 14 yrs, who were irradiated for lymphoid hyperplasia of the nasopharyngeal apparatus during the years 1937 to 1953. Four hundred and sixty-two families responded. The depth dose was calculated for a representative group of these patients and the technique employed is discussed. The dose-range was 320R to 600R, the vast majority falling between 441 R and 560R. Seventy-eight percent of the patients responding reported improvement in the condition for which therapy was given. Two children developed malignant neoplasms, one three and one-half years and the other six years after therapy. The findings are of clinical interest rather than statistical significance. (auth)

26499 THE RADIOLOGICAL DEMONSTRATION OF OSSEOUS METASTASES. EXPERIMENTAL OBSERVATIONS. **Edelstyn, G. A.; Gillespie, P. J.; Grebbell, F. S. (Northern Ireland Radiotherapy Centre, Belfast). Clin. Radiol., 18: 158-62(Apr. 1967).**

The efficiency of conventional radiological methods in detecting osseous destruction was investigated. Using human lumbar vertebrae, detection of a defect on lateral x ray was only possible when between 50% and 75% of the cancellous bone thickness was removed, while on anterior-posterior views a greater deficit was necessary. The practical implications of these observations to initial radical therapy of certain cancers and also to subsequent endocrine and chemotherapy are discussed. The need for an alternative more sensitive method for detecting changes in bone structure is obvious. (auth)

26500 PROSPECTS FROM THE TREATMENT OF THYROID CARCINOMA WITH RADIOIODINE. **Pochin, E. E. (London Univ.). Clin. Radiol., 18: 113-25(Apr. 1967).**

The bases and techniques of the radioiodine treatment of patients with thyroid carcinoma, particularly with inoperable and histologically differentiated tumors, are discussed in the light of 200 patients for whom this therapy was attempted during the last 18 years. Radioiodine uptake has developed in over 80% of differentiated tumors, although more commonly at 1½ or 3 months after thyroid ablation than at or before the time of ablation. Treatment may fail despite the development of uptake, more often because tumor irradiation was inadequate than because whole body radiation was excessive. During effective therapy, quantitative measures of tumor activity, by counting or from the plasma protein bound radioiodine concentration, give a valuable guide to the progress of treatment. An average of six radioiodine doses of 150 mCi each (given during 3 years) were required to abolish all evidence of any remaining tumor activity. Bone marrow depression is rarely seen unless bone metastases are present. (auth)

26501 KINETIC CRITERION OF THE APPLICABILITY OF INHIBITORS OF FREE-RADICAL PROCESSES IN RADIOBIOLOGY AND ONCOLOGY. Burlakova, E. B.; Khrapova, N. G.; Shtol'ko, V. N.; Emanuel, N. M. (Inst. of Chemical Physics, Moscow). Dokl. Akad. Nauk SSSR, 169: 688-91(July 21, 1966). (In Russian).

Characteristics of free-radical inhibitors applicable to radiobiology and oncology were studied. An attempt was made to establish the relation between radioprotective and tumor-preventing properties of inhibitors and the free radical reactions. Inhibition was evaluated by their ability to retard the simulated reactions of the thermal oxidation of oleic acid. Chemoluminescence was used for determining the elementary constant K_7 of the inhibitor reaction with peroxide radicals. Results showed that the phenols with high antiacid effects E and small constant K_7 may be applied in oncology and various oxypyridines of the mono-tertiary butyl derivative of phenol for radiobiology. (R.V.J.)

26502 NEW DATA ON THE RAY-PROTECTIVE EFFECT OF THE PANTOTHENIC ACID. Szorady, I.; Gazdagh, I.; Kocsor, Zs. Magyar Radiol., 19: 98-103(Apr. 1967). (In Hungarian).

After whole-body irradiation of the rat the previously administered pantothenic acid exerted favorable influence on the rat's weight, appetite, the number of the granulocytes, lymphocytes and thrombocytes,—also the span of life of the rats increased after this treatment. (auth)

26503 DETERMINATION OF RADIATION CHANGES AND METASTATIC INVOLVEMENT OF THE PELVIC LYMPH SYSTEM WITH THE AID OF LYMPHOGRAPHY. Vishnevskaya, E. E.; Trushnikova, E. V. (Research Inst. of Oncology and Radiology, Minsk). Vop. Onkol., 13: 32-8(1967). (In Russian).

Analysis of 130 roentgenological studies in 74 patients with cancer of the cervix is reported in which parametric recurrence and metastases into the iliac lymph nodes after the combined radiotherapy were suspicioned. Roentgenological diagnostic tests of radiation changes and metastatic lesions are described. The use of lymphography is felt to be rational for diagnosis of parametric recurrence and metastases into the pelvic lymph nodes after previously performed radiotherapy for cancer of the cervix uteri. (auth)

26504 ON THE INCREASE OF RADIORESISTANCE OF ESCHERICHIA COLI B/r. Zhestyanikov, V. D.; Val'dshtein, E. A. (Inst. of Cytology, Leningrad). Dokl. Akad. Nauk SSSR, 169: 220-2(July 1, 1966). (In Russian).

Radiosensitivity of *Escherichia coli* B/r and B_{s-1} growing on normal and glucose-containing media was studied with bacteria exposed to γ and x rays. Data revealed that both the γ- and x-ray resistance of glucose cultures of *E. coli* B/r are considerably higher (by 2.1 to 1.9 factor) than that of normal culture. The hypothesis that glucose effects depend primarily on postradiation recovery was confirmed. (R.V.J.)

26505 LABELED FLUOROBORATE IN THE STOMACH OF RATS. Matthews, C. M. E. (Hammersmith Hospital, London). Nature, 214: 933-5(May 27, 1967).

Fluoroborate-^{18}F has been used for the detection of brain tumors by scanning; its advantages are briefly enumerated. Distribution of labeled fluoroborate was studied in rats after intravenous injection; it was found that uptake into the stomach can be as high as about 30% of the injected dose with carrier-free fluoroborate, but this may be reduced by giving perchlorate or by addition of carrier. Uptake in subcutaneously (flank) transplanted tumors was also measured, and tumor/brain concentrations are given. Concentrations of labeled fluoroborate in most organs were similar to the average for the whole-body, but the stomach showed much larger values. Presumably fluoroborate is concentrated in the stomach in the same way as iodide. The estimated radiation doses to human stomach and gonads are given. It is concluded that labeled fluoroborate is not quite so favorable for brain scanning as appeared, but still compares well with other positron emitters. Possibly carrier-free labeled fluoroborate would be useful for stomach scanning. (UK)

26506 EPIDEMIOLOGY OF HUMAN LEUKEMIA: RECENT OBSERVATIONS. Fraumeni, Joseph F. Jr.; Miller, Robert W. (National Cancer Inst., Bethesda, Md.). J. Nat. Cancer Inst., 38: 593-605(Apr. 1967).

Review of recent epidemiologic studies into the origin of human leukemia revealed the following: Mortality statistics have for the first time showed a downturn in leukemia rates for all ages from 1 through 74 years among the U. S. white population, but not among the U. S. nonwhite population or in England. The possibility that this decline resulted from decreasing exposure to x rays in medical practice was not supported by an analysis of the limited mortality data available on cytologic types which should be unequally affected by radiation. Recent leukemia mortality rates for Japanese and U. S. nonwhite children suggest the emergence of an age peak at 3-4 years similar to that previously found among the U. S. white population and in England. Little evidence was found to support the hypothesis that aggregates of childhood leukemia or patient-pet clusters represent foci of infection. Despite recent searches for other infectious patterns in the distribution of human leukemia, the observation most suggestive of a viral influence is the geographic distribution reported for Burkitt's lymphoma in Africa. Recent observations have extended knowledge of groups who are born with or who acquire, from ionizing radiation or chemicals, a high risk of leukemia. Compilation of case reports of certain genetic diseases suggested that the heritable disorders associated with cytogenetic defects predispose to leukemia, whereas disorders with immunologic deficiencies are related to the lymphomas. There was a consistency among these observations which supports the notion that the pre-existing abnormalities have pathogenic significance, rather than being concomitants of the neoplastic process. Further study of high-risk groups should significantly enhance opportunities for recognition of etiologic agents and mechanisms in leukemogenesis. (auth)

26507 RADIOPROTECTIVE EFFECTS OF SEROTONIN ON BONE MARROW AND INTESTINAL LESIONS IN THE IRRADIATED RAT. Jovanovic, Dj.; Dunjic, A. (Univ., Louvain, Belg.). J. Belge Radiol., 50: 111-16(1967). (In French).

Intraperitoneal injection of 15 mg/kg of serotonine 5 minutes prior to irradiation reduces the mortality due to intestinal and bone marrow syndromes. Protective action in bone-marrow syndrome is specially characterized by accelerated regeneration. If the drug is injected 5 minutes after the irradiation there is no curative effect. Doses of 15 mg/kg already cause a lethal toxic manifestation in approximately 20% of irradiated rats. (auth)

26508 STUDY OF THE REAL TISSUE CONCENTRATION OF RADIOACTIVE TRACERS, USED FOR THE EXTERNAL DETECTION OF CEREBRAL TUMORS. Dereymaeker, A; De Roo, M.; Dardenne, G. (Univ., Louvain, Belg.). J. Belge Radiol., 50: 69-77(1967).

By using an original technique, permitting elimination of the radioactivity of blood contaminating the tissue samples, the authors have measured the real parenchymatous accumulation ratios of RISA ^{131}I and neohydrin ^{203}Hg in 43 cases of human cerebral neoplasy. The accumulation ratio tumor-brain tissue was established in each case. The study of the results of these measurements led us to conclude that there exists only a relationship between the histological type of the tumors and the concentration of tracers in their tissues in some of these lesions. (auth)

26509 POSTMORTEM ANGIOGRAPHY. A NEW MEDIUM AND TECHNIQUE. Evans, Hilary (Peter Bent Brigham Hospital, Boston. Harvard Medical School, Boston). Arch. Pathol., 83: 479-84(May 1967).

A new postmortem angiographic medium and method of injection are described. The injection medium consists of a barium sulfate gelatin suspension to which potassium iodide in high concentration was added. The addition of potassium iodide provides greater radiopacity without increasing the viscosity and also prevents the gelatin from hardening except on contact with formalin. Furthermore, the substitution of potassium iodide for lead or mercury obviates the hazard of toxicity to handlers. Since the medium uniformity fills vessels of lumen diameter down to 50μ but does not fill capillaries, the method is particularly useful for the demonstration of precapillary anastomoses and small-vessel patterns. The postmortem coronary and pulmonary angiograms are sufficiently detailed for correlation with clinical angiograms. The method is applicable to the demonstration of the arterial supply of any vascularized organ or tissue. (auth)

26510 SURGICAL TREATMENT OF RADIATION ULCERS. Chaplinskii, V. V. Vestn. Khirug., 93: 106-9(Aug. 1964). (In Russian).

Two female patients (21 and 37 yr old) and one male patient (40 yr old) with radioinduced skin necrosis were studied and treated. The ulcers developed after the patients underwent x-ray therapy of the foot and knee of 2 patients (10 radiation doses for a total of 3000 R), and after x irradiation of the stomach of the third patient. Usual methods of treatment of the lesion which developed, such as use of bandages with antiseptics, various ointments containing antibiotics and vitamins, and plaster-of-Paris compresses were without success. Then it was decided to attempt to cure the lesions surgically. Blood transfusions were given to the patients after which necrotic tissue was removed around the lesion. Skin was removed from the pelvic area for plastic surgery to replace the tissue removed from the affected areas during debridement. From observations on these 3 cases it was concluded that the only reliable treatment of chronic x-ray-induced skin lesions is radical removal of necrotic tissue followed by plastic surgery. (BBB)

26511 HIGH SPEED SECTION SCANNING OF THE BRAIN. **Crandall, P. H.; Cassen, B. (Univ. of California, Los Angeles). Arch. Neurol., 15: 163-71(Aug. 1966). (UCLA-34P119-4).**

The development of a new radioisotope detector with wide-angle collimator and large crystal has permitted greater depth resolution or section scans at much higher speeds. Single scans are made in four to eight minutes. The acquisition of multiple views in a short time assists clinical diagnosis by flexibility in the mode of examination. The coordinates of radioactivity from unmagnified planes are measurable when related to external skull landmarks. With improved resolution in depth, there is elimination of interference from sources outside this plane as well as enhancement of the resolution of the image within this plane. Changes in size of the image from tumors have been demonstrated at various levels as well as alterations in configuration. Further work is in progress to improve imaging of the anatomical boundaries of various pathological lesions in which there is a defective blood-brain barrier and which, when combined with the site of predilection, may assist in diagnosis of the nature of lesions. (auth)

26512 PALLIATION VERSUS ERADICATION OF CARCINOMA OF THE BLADDER WITH THE 70-MeV SYNCHROTRON. Hinman, Frank Jr.; Louie, Rose V.; Stone, Robert S.; Ferguson, David W. (Univ. of California, San Francisco). pp 200-7 of XIII Congress Society of International Urology, August 29 to September 5, 1964. Vol. 2.

An evaluation of the palliative, in contrast to the curative, effects of radiation therapy with the 70-MeV synchrotron was undertaken in 83 patients to determine if the special qualities of this high-voltage radiation produced palliation in advanced carcinoma of the bladder superior to that of ordinary high voltage, and to compare complications with those from lower energy therapy. There are apparently no biological effects from 70-MeV x rays that are different or more advantageous than those from ^{60}Co γ rays. The advantages that do exist with 70-MeV x rays are in the pattern of distribution of the absorbed dose. The maximum absorbed dose falls deep within the body, at a depth of 10 cm of tissue, compared to 0.5 cm with ^{60}Co. The patient's ability to tolerate the therapy is greatly enhanced and systemic reactions are few. Of the 83 patients receiving full treatment, 70% had significant palliation and 30% were not benefited; 27% poorly tolerated the treatment itself. Systemic tolerance to this high-energy radiation could not be measured. The 70-MeV x-ray beam made possible the treatment of patients with a lower integral dose than that of low-energy x ray. Fewer systemic reactions seemed to occur, even though statistics were not available to prove it. Complications occurred in 14 patients. Urinary fistula, usually associated with breakdown of tumor, and bowel injury were most frequently encountered. Only four patients (4.8%) had serious reductions in bladder capacity. (BBB)

26513 INVASIVE CERVICAL CARCINOMA DURING PREGNANCY. Roddick, J. W. Jr.; Crossen, P. S. (Univ. of Kentucky, Lexington). Amer. J. Med. Sci., 251: 736-45(June 1966).

A review, referring to 63 previous reports, is presented on the treatment of cervical cancer during pregnancy, giving a survey of the problems encountered in the use of radiation and disposition of the irradiated fetus. The largest number of institutions reporting the treatment of cervical cancer during pregnancy use irradiation as the treatment of choice. The major difference in the various reports is the means of disposition of the fetus. The results of irradiation therapy in pregnant patients with cervical cancer are tabulated for 9 large clinics. (TSS)

26514 THE ROLE OF RADIOACTIVE PHOSPHORUS (^{32}P) IN THE LOCALIZATION OF VULVAL LESIONS. Thoms, George (Royal Melbourne Hospital). Austral. New Zeal. J. Obstet. Gynaecol., 5: 241-8(Nov. 1965).

A method developed for use of ^{32}P to detect vulval lesions was applied to 200 patients. An estimation was made of the radiation exposure to the subject. This use of ^{32}P to differentiate between malignant and nonmalignant tissue of the vulva is an extension of the earlier studies of the use of this isotope in the diagnosis of intra-ocular and cutaneous melanomas. Radiophosphorus demonstrates rapidly dividing cells since it is removed from the blood with selective concentration in neoplastic tissue. Before a state of equilibrium between the intracellular and extracellular ^{32}P has been established, elevated uptake measurements may be observed in inflammatory conditions because of greater blood flow. This should be considered when results based on tissue content of ^{32}P are interpreted. Diagnostic tests involving doses of this order are undesirable during pregnancy and it is necessary to ascertain the pregnancy status of women before performing this test. Radiophosphorus is selectively concentrated in bone and if more than 2 tests are needed in 1 yr, a white cell count should be performed before the third test is permitted. (TSS)

26515 REACTION OF THYROID GLAND TISSUES TO THE STIMULANTS AT DIFFERENT LEVELS OF HORMONAL BALANCE AND RADIATION SICKNESS. **Dunaev, P. V. (Tiumen Medical Inst., USSR). Byull. Eksp. Biol. Med., 63: 109-12(Apr. 1967). (In Russian).**

The author studied the reaction of thyroid gland tissues to tar in healthy and in partially thyroidectomized and irradiated (500–800 R) immature and adult rabbits. He found different reactive properties of the epithelium of various follicles. Proliferation of thyroid epithelium in the shape of monolayer, multiple row ciliated and multilayer strata on the border of viable and necrotic tissues of the invasive type were obtained. Relationship between the regenerative processes in the thyroid gland to the general condition, age and hormonal balance of the body was noted. The author suggests the evolution of the thyroid gland from a prechordal lamina. (auth)

26516 CORRELATIONS BETWEEN TIME OF CEREBRAL CIRCULATION WITH RADIOISOTOPES AND MORPHOLOGICAL ASPECTS OF CAROTID ANGIOGRAPHY. **Baggio, G. F.; Morgando, E.; Bergamasco, B.; Gandiglio, G.; Monticone, G. F. (Univ., Turin). Minerva Radiol., Fisioterap. Radiobiol., 12: 1-5(Jan.-Feb. 1967). (In Italian).**

The results of measurements of cerebral circulation time with radioisotopes were compared with the carotid angiographical report in 120 cases. It was observed that the group with normal circulation times (C.T.) presented 34% of the pathological angiographies, those with pathological C.T. and equal for the two hemispheres presented 47%, while the group with pathological C.T. and different for the two hemispheres presented as high as 84.6% of the pathological angiographies. The significance of this latter result suggested a detailed analysis of cases with pathological C.T. different from one hemisphere to the other. From this study it is concluded that a different C.T. from one hemisphere to the other is the expression of lateralized cerebral trouble which may be due to a vascular malformation or occlusion, or to a space-occupying lesion. The practical usefulness of the R.R.G.G. examination is pointed out. When this reveals a difference in C.T. between the two hemispheres, carotid angiography should be carried out. (auth)

26517 QUANTITATIVE CHARACTERISTIC OF RESTORATIVE PROCESSES IN CERTAIN SYSTEMS OF THE BODY AFTER RADIATION LESIONS. **Gorlov, V. G.; Bobrovnikov, I. D. Byull. Eksp. Biol. Med., 63: 45-8(Apr. 1967). (In Russian).**

Restoration as assessed quantitatively through resistance to repeated gamma-radiation bears an exponential character with a period of semi-restoration of 7 days. Relationship of residual lesion with the state of certain physiological systems of the body is shown. High degree of correlation between the residual lesion and changes in the bone marrow and phagocytic activity stresses the important role of these systems in the total effect of the lesion and restoration. (auth)

26518 REACTIVE CHANGES IN THE CENTRAL NERVOUS SYSTEM AND ENDOCRINE ORGANS IN BURN IRRADIATION LESIONS. **Pilipenko, N. I. (Kharkov Medical Inst.). Byull. Eksp. Biol. Med., 63: 48-52(Apr. 1967). (In Russian).**

With the aid of vital stains the author studied alterative changes in the regulation organ tissues after burn irradiation lesions. He found that the depth of alteration in the large hemispheres, the cerebellum, medulla oblongata, hypophysis, adrenals, thyroid and pancreatic glands is greater after combined burn and irradiation lesions as a rule than when these factors act independently (thermal burn or general irradiation). It is suggested that increased upset of the controlling organs may be one of the causes of deterioration of general condition of irradiated animals after addition of a thermal burn. (auth)

26519 CATECHOLAMINE CONTENT IN ORGANS OF ANIMALS DEAD FROM ACUTE RADIATION SICKNESS. **Kulinskii, V. I.; Kostyukovskaya, L. S. (Ukranian Inst. of Postgraduate Study, Kharkov). Byull. Eksp. Biol. Med., 63: 59-60(Apr. 1967). (In Russian).**

Guinea pigs, dead after irradiation with 500 R, had a considerable decrease of adrenaline in the adrenals and of noradrenaline in the heart, spleen, large cerebral hemispheres and the brain stem, as well as accumulation of noradrenaline in the adrenals. Animals with internal bleeding had accumulation of adrenaline in the heart. The authors studied the relation of these changes with various manifestations of radiation sickness and discussed their types. (auth)

26520 GALLIUM EDETATE (^{68}Ga) EXPERIENCES IN BRAIN-LESION DETECTION WITH THE POSITRON CAMERA. **Schaer, Leonard; Anger, Hal O.; Gottschalk, Alexander (Univ. of Cali-**

fornia, Berkeley). J. Amer. Med. Ass., 198: 811-13(Nov. 21, 1966).

Gallium-68 has a half-life of 68 min and decays by positron (β^+) emission. Because of the short half-life, there is little radiation hazard to the patient. An intravenous dose of 700 to 750 μCi gives a whole-body dose of less than 30 mrad, and a renal dose less than 150 mrad. The ^{68}Ga edetate is easily obtained by an ion exchange process from a Ge–Ga generator (isotope cow). Gallium-68, the daughter of 270-day ^{68}Ge, is obtained by passing edetate solution through an alumina column upon which ^{68}Ge is placed. The edetate becomes labeled with the short half-life ^{68}Ga, while the ^{68}Ge remains on the column to be milked again. Hence, a further advantage of this radioisotope is that it is available at all times and requires no elaborate equipment for its preparation. The compound accumulates in most brain tumors and, using the positron form of the scintillation camera, pictures of the distribution of this radioisotope in the patient's head can be obtained. The lesions appear as an area of increased uptake of radioisotope. In 96 patients, 41 cases with subsequently proved abnormalities were accurately diagnosed by this method. Nine cases with abnormalities were missed. Low radiation hazard to the patient, ease of preparation, and constant availability of the tracer compound at low cost make this radioisotope an excellent tracer for localizing brain tumors in conjunction with the positron scintillation camera. (BBB)

26521 PREVENTION AND THERAPY OF RADIONECROSIS OF THE MANDIBLE. Stea, G.; Bono, F.; Babini, L. (Istituto Clinico per le Malattie della Bocca "A. Beretta," Bologna). Riv. Ital. Stomatol., 21: 289-308(Mar. 1966). (In Italian).

The etiology, pathologic anatomy, clinical symptoms, and radiologic picture of mandibular osteoradionecrosis are presented with reference to the literature and to clinical evidence. Problems associated with prevention and treatment of radioinduced injury to the jaw in the course of cancer therapy are also considered. This complication was reported in 5.6 to 50% of patients irradiated for cancer of the oral region. Isodose contour charts are provided for ^{60}Co irradiation techniques in this region, showing that by proper planning tumoricidal doses of 6000 R or higher can be applied to the tumor while sparing the mandible. Gross and histologic specimens are illustrated to demonstrate the results of mandibular irradiation injury. Fistula formation and pathologic fracture of the mandible occurred in several of the cases. Large osteolytic foci were detected radiographically and confirmed upon surgical removal of the devitalized bone. Prophylactic measures recommended include limitation of the beam to avoid excessive irradiation of bone and cartilage, removal of carious teeth within the irradiated field, and attention to oral hygiene. Treatment of osteoradionecrosis of the mandible in severe cases necessitates surgical removal of the sequestered bone. (BBB)

26522 THE MEASUREMENT OF ^{47}Ca IN THE FOREARM AS AN INDICATION OF CALCIUM METABOLISM IN HUMANS. Harmut, Magda (Inst. of Medical Research, Zagreb). pp 171-6 of Proceedings of the Second Symposium on Health Physics. Vol. I. Budapest, Publishing Group of the Central Research Institute for Physics, 1966.

See CONF-660948–(Vol.1).

The purpose of this study was to evaluate the measurement of ^{47}Ca in the forearm as an indicator of calcium metabolism in humans. This preliminary report includes data on two normal subjects and two patients with calcium metabolic disorders. The following three methods were used: measurement of the activity of the forearm, estimation of the whole-body activity, using a simple chair technique, and determination of fecal and urinary activity. Retention figures obtained by these three methods were compared. Results indicate that the technique of measuring ^{47}Ca in the forearm, described in this paper could be used as an indication of calcium metabolism in human tracer experiments. The retention values obtained by this technique are within ten percent of the values obtained by standard methods. (auth)

26523 INVESTIGATIONS OF THE ^{131}I CONTAMINATION AT THE WWR-S RESEARCH REACTOR. Nemeth, A.; Toth, M. (Central Research Inst. for Physics, Budapest). pp 177-82 of Proceedings of the Second Symposium on Health Physics. Vol. I. Budapest, Publishing Group of the Central Research Institute for Physics, 1966.

See CONF-660948–(Vol.1).

Experiments have been performed for the determination of airborne ^{131}I activity by activated charcoal bed filter. The method has been used for checking the ^{131}I contamination at the outlet of the venting shaft, in the ambient atmosphere and in the air within the reactor premises. The ^{131}I contamination of the primary cooling water circuit of the reactor was determined by means of carbon tetrachloride extraction. (auth)

26524 NEW APPLICATOR FOR INTRAUTERINE RADIUM THERAPY: PREVENTATIVE NOTE. Granone, F. G.; Juliana, G. (Univ., Turin). Minerva Radiol., 9: 278-82(June 1964). (In Italian).

A new Ra applicator is described which gives better dose distribution in the uterus and adnexae while reducing the exposure of radiosensitive structures such as the bladder and rectum. The applicator has three terminal branches which can be extended after insertion, each holding a Ra source. This provides for an improved dose distribution in the fundus. It can be quickly inserted, reducing personnel exposure, since in its collapsed state it has a dia of only 10.8 mm. The apparatus is customarily loaded with five 20-mg Ra sources, filtered with 1 mm Pt, which give an endometrial dose rate of 600 R/hr and a dose rate to the external uterine wall of 120 R/hr. The usual treatment is for 60 hr in two sessions. The bladder and rectum doses are moderate, less than 3% of the endometrial dose. (BBB)

26525 THE INFLUENCE OF MASSIVE DOSE IRRADIATION OF ^{60}Co TO THE MAMMAL. 2ND REPORT. ON THE MICROSCOPIC OBSERVATIONS OF IRRADIATED ORGANS. Kurosawa, Hiroshi; Moriya, Hiroshi (Toho Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 26: 1173-9(Dec. 1966). (In Japanese).

A report is presented on the acute death of the mammals after irradiation with massive doses from Co-60. We studied the microscopic findings after 10,000 R and 30,000 R whole body irradiation. We used 10 male guinea pigs in each group. Examined organs were spleen, brain, lung, lymph-node, skin, testis, liver and bone marrow etc. Results obtained were as follows. In almost all tissues, the main finding in early period of irradiation was hyperaemia. Partial cell degeneration could be seen. DNA and RNA content decreased remarkably in liver cells. But, the definitive conclusions to the acute death of guinea pigs could not be seen in our microscopic research. We have supposed that further neurophysiological and histochemical research is necessary to find out the cause of acute death. (NSA of Japan)

26526 CERVICAL RADIOMETRY. Andrews, J. M. (California Coll. of Medicine, Los Angeles). Arch. Phys. Med., 47: 238-44(Apr. 1966).

A new x-ray technique was developed as an objective, reproducible method of measuring flexion-extension range of the cervical articulations. Measurements were made under controlled conditions and standard deviations calculated. Lateral x-ray views of the cervical spine in flexion and extension were made with the subject sitting in a chair provided with straps to immobilize the pelvic and shoulder girdles. The target area was the fifth cervical vertebra at a distance from x-ray tube of 6 ft. The subject flexed his head and neck fully for the first exposure and then extended the head and neck fully for the second. The measurements made on the films represented the range of motion of the cervical spine at the various levels, from C1 to C6, using C7 as a reference point. The total excursion in flexion and in extension was calculated (in degrees) for each level, and graph was plotted for each subject. Examination of the graph indicated that the line representing the total range at each level tends to be linear in the normal individual. Sharp deviations in any portion of this line indicate either restricted or increased mobility, depending on their direction. (BBB)

26527 REPETITIVE CORRECTION FOR A FINITE RESOLVING POWER OF THE COLLIMATOR IN SCINTISCANNING. Iinuma, T. A.; Nagai, T. (National Inst. of Radiological Sciences, Chiba, Japan). Int. J. Appl. Radiat. Isotop., 18: 325-7(May 1967).

The most inherent problem in scintiscanning is the contradiction between resolving power of the collimator and detection efficiency. The best spatial resolution would be obtained with a detector of zero sensitivity (= infinite collimation). If the distortion in a scintigram due to a limited resolution of the collimator can be corrected, a better compromise between the two opposing factors may be obtained. A correction method described is based upon the iterative approximation that has been used in correcting a distortion of β- or γ-ray spectra due to a finite energy resolution of the detectors. As an example the method is applied to correct the whole-body distribution of ^{132}Cs following oral administration. In principle the method might be applied in any type of scintiscanning provided the data are available in digital form. High-resolution scintigrams with high energy γ-emitters (^{59}Fe, ^{60}Co, ^{47}Cs, etc.), that are difficult to obtain by conventional methods, might be obtainable with this correction. The method could also be used in analyzing scintigrams with smaller amounts of tracers. (UK)

26528 MANAGEMENT OF MYELOPROLIFERATIVE DISEASES. Raccuglia, Giovanni (Univ. of Louisville, Ky.). GP, J. Amer. Acad., 34: 144-53(Sept. 1966).

Use of external radiotherapy and radioisotopes to treat leukemia, polycythemia vera, and related diseases is reviewed. X-ray therapy is rarely used today in chronic granulocytic leukemia unless reduction of leukemic masses or infiltrations in specific areas are indicated. Internal irradiation by radiophosphorus, however, is still widely used. Sustained remissions may be obtained by intravenous administration of 3 to 5 mCi of ^{32}P. For polycythemia vera a routine program of management may include administering 4 to 6 mCi of ^{32}P. Results of this treatment begin to appear 4 to 6 weeks after administration of the isotope. Most patients respond well. Lack of reduction of the hematocrit or rapid return to high values after phlebotomies and ^{32}P therapy indicates that the treatment has been ineffective. More than one dose of ^{32}P may be required. An increase of the hematocrit above 50% in women and 55% in men generally indicates the need for additional ^{32}P unless the patient has already received 20 mCi within the year. Thrombocythemia, a rare hematologic disease characterized by disorderly growth of megakaryocytes and production of platelets, is best treated with small doses of ^{32}P. (BBB)

26529 THERAPY OF CUSHING SYNDROME BY IMPLANTATION OF ^{90}Y IN THE HYPOPHYSIS. Kleinfelder, H.; Boerner, W.; Nadjmi, M.; Husmann, F. (Staedtische Krankenanstalten, Nuremberg). pp 172-5 of Eleventh Symposium Deut. Ges. Endokrinol., 1964. Berlin, Springer-Verlag, 1965. (In German).

Treatment of two patients with Cushing's Syndrome by implantation of ^{90}Y by way of the transorbito-sphenoidal path was studied by steroid excretion measurements. The activity implanted was 3.4 to 4 mC, contained in two rods. Excretion of 17-OH-corticosteroid and 17-ketosteroids decreased to 5 to 10 mg/day two or three days after implantation and remained at this level or decreased for the next two yr. The clinical symptoms of the syndrome disappeared completely. No hypofunction of the thyroid could be detected by ^{131}I tests. One case developed and rhinorrhea appeared several weeks after ^{90}Y implantation, but this resolved spontaneously. One yr after implantation the excretion of 11-deoxycorticosteroid was lower than in healthy persons. According to an ACTH test the adrenal cortical response was normal, amounting to an increase of the 17-OH-corticosteroid in plasma from 18 to 30 μg/100 ml. The most outstanding facts that were observed were the relatively small doses of ^{90}Y necessary to produce complete remission of the clinical picture and the evidence for appearance of a therapeutic effect, without apparent decrease in gonadal and thyroidal functions. Up to this date only 13 cases of this syndrome have been treated by ^{90}Y implantation. (TSS)

26530 MACROMOLECULAR COMPOUNDS AS POTENTIAL PROPHYLACTICS AGAINST IONIZING RADIATION. **Ringsdorf, Helmut (Univ., Marburg, Ger.). Strahlentherapie, 132: 627-35(Apr. 1967). (In German).**

Polymers are discussed as long lasting radiation prophylactics and are compared to their low molecular weight model compounds. Several polymers containing protective groups are described. (auth)

26531 DESCRIPTION OF RADIATION FIELDS BY SEPARATION OF PRIMARY AND SCATTERED RADIATION. II. THE TISSUE-AIR-RATIO IN ^{60}Co-FIELDS. **Schoknecht, Guenter (Auguste-Viktoria-Krankenhauses, Berlin). Strahlentherapie, 132: 516-28(Apr. 1967). (In German).**

The tissue-air-ratio (TAR) can be defined in a more general, and for application, more suitable form. Due to the method of equivalent fields, the experimental investigations can be limited to square fields. Analytical representations of the TAR are obtained by experimental results. The scattered dose/air dose ratio and the relative depth dose distribution are derived from the equations obtained. A general dose equation for points located in the central beam within a water equivalent absorbing medium is derived. The equations obtained can be interpreted physically, and allow a separation of the primary and the scattered radiation dose. The results are evaluated by computers which allow a comparison with results obtained by others. (auth)

26532 THE SIGNIFICANCE OF BIOCHEMICAL STUDIES ON CONNECTIVE TISSUE DURING RADIOTHERAPY. II. THE CHEMICAL VALUE OF COMPARATIVE STUDIES OF HEXOSE, HEXOSAMINE, SERUMUCOIDES, AND SERUM ENZYMES IN TUMOR PATIENTS DURING RADIOTHERAPY. **Kaercher, Karl Heinz (Univ., Heidelberg). Strahlentherapie, 132: 559-72 (Apr. 1967). (In German).**

The behavior of the serum-hexoses, hexosamines, and the seromucoides during radiation therapy is described. It was observed that a simultaneous observation of the behavior of the structural elements of the connective tissue, certain serum enzymes, the trias-electrophoresis, and of the blood sedimentation reaction gives a multidimensional view of the tumor events as well as of the interaction between tumor and surrounding tissue before and after the influence of ionizing radiation. It was shown that additional information about the extent of the radiation-induced tumor inactivation as well as about the reaction of the normal surrounding tissue can be obtained especially by investigating the structural elements of the connective tissue. Especially, a differentiation of malignant lung changes from pure inflammatory-degenerative changes seems to be possible. The advantages of these biochemical studies during high voltage therapy of malignant tumor are discussed. (auth)

26533 INFLUENCE OF X RADIATION ON COMPENSATION-HYPERTROPHIC GROWTH OF RAT KIDNEY. **Bogatzki, Marianne; Erdelt, Herwig; Schnepper, Elmar; Schuetz, Juergen (Univ., Muenster, Ger.). Strahlentherapie, 132: 573-83(Apr. 1967). (In German).**

The compensatory-hypertrophic growth of a rat kidney after removal of the other kidney is influenced considerably by x ray therapy. Irradiation with 1000 R accelerated the hypertrophic growth, while an irradiation with 5000 R caused disturbances in the metabolic processes which resulted in an inhibition of the hypertrophic growth. The DNA- and RNA-content was increased in the kidney tissue, which was more significant after administration of higher x ray doses, and which was accompanied by a decrease in the protein concentration. These results emphasize that x-irradiation of the kidney, especially when one kidney has already been removed, should be done only after careful examination. (auth)

26534 RECOVERY OF HEMATOPOIESIS IN ACUTE RADIATION SICKNESS FOLLOWING TRANSPLANTATION OF POLYCYTHEMIC BONE MARROW. **Zographov, Dimiter G.; Bonev, Luebomir E. (Forschungsinstitut fuer Radiologie und Strahlenhygiene, Sofia). Strahlentherapie, 132: 594-603(Apr. 1967). (In German).**

Using blood picture, relative myelogram, and 24-hour ^{59}Fe-incorporation into the erythrocytes, the recovery of the blood formation after transplantation of polycythemic bone marrow was determined 4, 8, and 12 days after x irradiation with 700 R. Compared with animals which had received normal bone marrow, a short time retardation of the recovery of the erythropoiesis and an acceleration of the regeneration of other cell groups was found. This does not depend upon the amount of blastic or potentially proliferable donor cells administered. The results obtained are discussed in view of the most recent knowledge about the regulation of the proliferation of the hemopoietic stem cells. The delayed recovery of the erythropoiesis after transplantation of polycythemic bone marrow is thought to be the result of a decrease in the titer of the endogenous erythropoetin in the acceptor. (auth)

26535 THE EFFECT OF POLYSACCHARIDE OF PULLULARIA PROTOTROPHA ON IRRADIATED EHRLICH TUMOR CELL. **Lobanok, A. G.; Bulanov, P. A. (Inst. of Experimental Botanics and Microbiology, Academy of Sciences, Belorussian SSR). Dokl. Akad. Nauk BSSR, 10: 430-3(June 1966). (In Russian).**

Within the framework of a study of the radioprotective effect of polysaccharides, the influence of Pullularia prototropha on irradiated ascitic Ehrlich tumor cells was investigated: this glucophosphomannan is known to exert a protective action on irradiated mice. The radioprotective agent was administered intraperitoneally to mice with a 7-day old ascitic tumor, 1 to 3 hours after, or at the time of the exposure. Growth of the tumor, the mitotic index and the frequency of chromosome injury served as indicators for the radiation effects. After an irradiation of 2100 R, the tumor cells were subcutaneously grafted into unexposed mice, adding the polysaccharide, and after incubation, the tumor cells. It was found that intraperitoneal administration of 1 mg of the polysaccharide per mouse increased the graftability of the tumor cells; the subcutaneous administration was not effective. Larger doses exerted a toxic effect. The in vitro addition of 50 to 150 γ/ml also increased the graftability. It was concluded that the protective action of the polysaccharide is related to its direct action on cell metabolism; the lack of effect in the case of subcutaneous administration is probably related to the fact that the polysaccharide enters the abdominal cavity in an inactive form. (TTT)

26536 ANTIRADIATION COMPOUNDS. VIII. REACTION OF THIOLS WITH CYANOGEN BROMIDE. **Foye, William O.; Hebb, Alicia M.; Mickles, James (Massachusetts Coll. of Pharmacy, Boston). J. Pharm. Sci., 56: 292-3(Feb. 1967).**

The reaction of dithiols with cyanogen chloride resulted in the formation of cyclic imino dithioester hydrochlorides. With the assumption that 2-mercaptoethylamine hydrochloride (MEA) might react with cyanogen bromide in analogous fashion, either an imino dithioester hydrohalide or iminothiazolidine would be obtained, and provide possibly an active antiradiation agent. The reaction of cyanogen bromide with other thiols was observed, and in each case the disulfide was formed. With 2-mercaptoethylguanidine (MEG), a compound corresponding to the disulfide was obtained from cyanogen bromide oxidation. Thus the reaction of a thiol with cyanogen bromide provides a specific synthesis of disulfides without further oxidation. The reaction is apparently general, and can be used not only for MEA and MEG but for any aliphatic, aromatic, and amino thiol. Oxidation of MEA with 3% H_2O_2 also gave the disulfide, but similar oxidation of MEG gave the thiolsulfinite, distinguishable from the disulfide by ir absorption in the 1100 cm^{-1} region. Antiradiation testing of MEA disulfide dihydrochloride revealed good protective properties in mice after 825 R. (BBB)

26537 CHEMOTHERAPY OF GLIOBLASTOMA MULTIFORME. **Owens, G.; Javid, R.; Belmusto, L. (Roswell Park Memorial Inst., Buffalo). pp 752-4 of Proc. Third Intern. Congr. Neurol. surg., Aug. 23-7, 1965, Copenhagen. Amsterdam, Exerpta Medica Foundation, 1966.**

Synergistic activity of radiation in the treatment of malignant glioma with vincristine sulfate is reported in this study of 59 patients. It was found that previously irradiated lesions tolerated smaller quantities of the drug as measured by the earlier and more severe appearance of scalp erythema, loss of hair, and the development of mild nausea and lethargy. It appeared, therefore, that radiation therapy would be useful in a synergistic fashion. The treatment included surgical decompression followed by intraarterial administration of 10 to 15 mg of vincristine via the ipsilateral carotid artery extended over a period of from 5 to 7 days, followed by radiation therapy (~3000 rad). A total of 44% of patients who received therapy is presently alive and has survived for an average of 18 months (from 10 to 26 months). (BBB)

26538 DEMONSTRATION OF A RADIOACTIVE SUBSTANCE IN THE LUNG OF A URANIUM MINER. **Backmann, R.; Grueter, H. J. (Univ., Muenster, Ger.). Verhandl. Deut. Ges. Pathol., 49: 300-4(1965). (In German).**

Alpha-ray activity of 6.9×10^{-14} C/g weight of fresh lung could be demonstrated in the lung of a 36-yr-old man, who had been working in a uranium mine for 3 years, 10 years ago; the activity was due to incorporated α-particle emitters which had probably been taken up in the course of the man's activity in the uranium mine. This α-ray activity was elevated, by about 10 to 20 fold as compared with normal lungs. It was possible to demonstrate the α-radiation by means of radioautography. Reticular fibrosis of the lung of the uranium miner was regarded as the consequence of intense radiation exposure. Fission products of the radioactive fallout could be demonstrated also in normal lungs by using γ-ray spectrometry. (BBB)

26539 HISTOPATHOLOGY OF LARYNGES AND RADICAL NECK SPECIMENS IN A COMBINED RADIATION AND SURGERY PROGRAM FOR ADVANCED CARCINOMA OF THE LARYNX AND LARYNGOPHARYNX. Goldman, Joseph L.; Cheren, Robert V.; Zak, Frederick G.; Gunsberg, Melvin J. (Mount Sinai Hospital, New York). Ann. Otol. Rhinol. Laryngol., 75: 313-35(June 1966).

Histologic examination was made of laryngeal tissue after ^{60}Co irradiation. Combined therapy of advanced carcinoma of the larynx and laryngopharynx consisted of a three-phase program with a 5500-rad tumor dose, followed by a waiting period of three to six weeks, and then a radical surgical procedure. The irradiated laryngeal and neck specimens removed at operation were subjected to processing with celloidin for serial section study. The results indicated that the clinical appearance of a larynx after exposure to therapeutic levels of irradiation is a poor indicator of whether or not that larynx contains residual cancer. Preoperative radiotherapy does not favor a less extensive curative surgical resection. Both areas of cancer-free tissue in the tumor bed and cancer islands close to the preradiation tumor margins were often found. A typical hyperplasia of the mucosa of larynges in areas not involved with cancer, particularly in the ventricles, was noted. The radiation reaction in mucous membranes, mucosal glands, muscles, nerves, blood vessels, cartilage, and elastic tissue is described. (TSS)

26540 INFLUENCE OF GIBBERELLIN AND INDOLYLACETIC ACID ON THE SENSITIVITY OF GERMINATING RICE SEEDS TOWARD X RAYS. **Lo, Tsung-lo; Fang, I-hsiung (Inst. of Plant Physiology, Chinese Academy of Sciences). Shih Yen Sheng Wu Hsueh Pao, 7: No. 1-2, 132-7(Dec. 1960). (In Chinese).**

Germinating rice seeds were soaked in solutions of gibberellin or indolyl-acetic acid before and after x-irradiation. Observations of seed germination revealed that neither gibberellin nor indolylacetic acid had a positive influence on lowering the harmful impact of irradiation. They fortified the intensity of growth of germinating seeds, and lowered their stability in germination. As a result, the lifespan of the seedlings was lowered. It is suggested that the intensity of growth is a defining factor in the sensitivity of the organism to irradiation. (CFSTI)

26541 TREATMENT OF CUSHING'S SYNDROME. **Heni, F. (Univ., Tuebingen, Ger.). Deut. Med. Wochschr., 91: 174-8 (Jan. 28, 1966). (In German).**

Because the surgical removal of small hypophyseal adenomas frequently is too radical because it is followed by hypophyseal insufficiency. The implantation of radioisotopes is the preferred method. Because of the long-range irradiation produced by ^{198}Au and the frequency of optical injuries produced, it is used only for rapidly growing tumors. Implantation of ^{90}Y is used frequently, but many risks are involved. These include complications such as rhinorrhea, infections, and visual field impairments, which can be largely prevented by a transethmoidal approach. In cases where a focal dose of from 15,000 to 20,000 R is used, results of treatment for small hypophyseal adenomas and the idiopathic bilateral hyperplasia of the adrenals are good and are equivalent to radical treatment of the adrenals themselves. The most important indication for surgical treatment of bilateral adrenal hyperplasia without evidence of hypophyseal tumor is a severe and advancing Cushing syndrome with cardiac decompensation, skin hemorrhages, renal failure, and lack of resistance to disease. (TSS)

26542 LOCATING PLACENTA WITH USE OF ^{125}I-TAGGED SERUM ALBUMIN: A PRELIMINARY REPORT. **Dragul, Philip C.; Baker, T. Hart (Southern California Permanente Medical Group, Los Angeles). Amer. J. Obstet. Gynecol., 96: 548-52(Oct. 15, 1966).**

Advantages of the use of ^{125}I- over ^{131}I-labeled albumin for placental localization is discussed prior to a description of a technique for placental location, using ^{125}I-tagged serum albumin and use of a portable placentogram machine in patients with painless vaginal bleeding in the last few weeks of pregnancy. This technique, believed to be as accurate as those using ^{131}I, has specific advantages: radiation dose to the patient is decreased; cost is less than that of other methods; and a portable machine is used, which can be brought to the patient. It is particularly useful in hospitals where no radioactive scanning device or uptake unit is readily available. The absence of β radiation, useless in diagnosis, gives ^{125}I a high photon merit ratio (usable signals/absorbed energy), allowing decreased total-body irradiation. Assuming 20% uptake, the dose used, 5 μCi of ^{125}I, would deliver a total dose of 4 RAD to the thyroid: a tracer dose of ^{131}I, 50 μCi, with the same percentage of uptake would deliver 65 RAD. It has the following advantages over ^{131}I: longer half life and shelf life, resulting in less waste; more convenient handling; low energy photons, yielding higher resolution; no β radiation; therefore, less total radiation per dose to mother and fetus; allows use of ordinary crystal scintillation counter (less massive and expensive than equipment for ^{131}I); and provides equal accuracy, with less total tissue dose of radiation. (BBB)

26543 EXPOSURE DOSE RATE AND ABSORBED DOSE RATE IN RADIUM AND ^{60}Co TREATMENT OF VOCAL CORD CARCINOMA WITH REFERENCE TO EXCEEDING THE USUAL INDICATION. **Minnigerode, B. (Univ., Goettingen, Ger.). Arch. Ohren., Nasen. Kehlkopfheilk., 185: 677-82(1965). (In German).**

The author compared the absorbed dose rate measured in air or phantoms consisting of cadaver larynges in patients with indwelling irradiators, or by endoscopic measurements. The results were generally similar in all three cases, except for the dose rate in the ventro-dorsal direction. This varied with the absolute size of the larynx, the angular position of the cartilage plates with one another in the anterior median line, and the necessarily greater distance between voice chord and radiation source in in the posterior laryngeal region due to insertion of the cartilage. This effect can cause a reduction of ~ half in the irradiation dose expected for the vocal chord. In spite of their automatically different structures the female and male larynx show the same basic relations. Differences between direct and indirect measurements of energy dose administered to the vocal chord were due to the heterogeneous combination of differing radiation absorption of the tissues such as cartilage and fat, and the boundary surface effects of the transition area. The differences between the results were made even more clear by the endoscopic measurements made in patients. The values decreased to a third or less of the air and phantom measurements so that on the average the maximum values of dose rate were close to the minimum values of the phantom and air measurements. This indicated that in using 10 mg of RaE for 6 days the dose rate amounts to 30 R/hr at the anterior third of the vocal chord, 10 R/hr centrally, and 8 R/hr posteriorly. These values are less than they are generally assumed to be. (BBB)

26544 THE ^{131}I THERAPY OF THYROID HYPERFUNCTION. **Horst, W. (Univ., Zurich). Verhandl. Deut. Ges. Inn. Med., 70: 861-2(1964). (In German).**

There are two fundamentally different types of thyroid hyperfunction consisting of the diffuse type that involves the entire thyroid parenchyma, such as Basedow's disease, and the toxic adenomas that involve one or more autonomous hyperfunction-ing adenomas. Toxic adenomas may vary considerably as to type, being classified histologically as fetal, papillary, embryonal, microfollicular, or macrofollicular. The author reports that in recent yr 30% of the cases of hyperthyroidism treated radiologically or surgically involved toxic adenomas. Because of the failure to propertly diagnose these cases and to treat them, 20 to 30% of toxic adenomas result in complications. After describing the procedures and results of ^{131}I studies used for diagnosis of toxic, autonomous adenomas, the results obtained by ^{131}I treatment and by surgical treatment are compared. A thorough consideration of the risks involved in the two types of treatment generally leads to a specific indication of the choice of treatment required. Today, both ^{131}I treatment and surgical operation offer the same assurance of successful results. (BBB)

26545 SPECIALIZED VIEWPOINTS IN THE RADIOTHERAPY OF MAMMARY CARCINOMA. Oberheuser, F. (Univ., Hamburg). Radiol. Austr., 15: 185-97(1964). (In German).

High-energy electrons are very suitable for treatment of mammary carcinoma because of their variable ranges in tissue. They range from 2.5 cm for 5-MeV electrons to 8 cm for 16-MeV electrons. Under therapy conditions there is a dose elevation increase beneath the skin surface, making up 10 to 20% of the surface dose. Beyond this the dose falls off gradually so that 80% of the surface dose is effective over $^2/_3$ of the electron range. The doses decrease to zero rapidly in the last $^1/_3$ of the electron range. This pattern permits almost uniform irradiation of volumes whose thickness is $^2/_3$ of the electron range, provided that the tissue is relatively homogeneous. Ultrahard x rays of 15 MeV from the betatron have a dose maximum at 3 cm depth. The depth dose curve falls off gradually from this. The dose at 20 cm depth has the same height as the surface dose, corresponding to ~40% of the maximum. The dose maximum is displaced deeper with increasing energy. Because of a buildup effect ^{60}Co irradiation produces a dose increase ~5 mm beneath the skin surface. The dose increase is somewhat less, and the dose decrease is steeper beyond the maximum observed with 15-MeV x irradiation. Both ^{60}Co and ultrahard x radiation show small scatter, thus providing of sharp limitation of the beam internally. Absorption by soft and hard tissues is relatively uniform. For these reasons ^{60}Co therapy is more suitable for irradiation of tumors located deep in the body, but it can also be used for treatment of mammary carcinoma if tangential methods are applied. (BBB)

26546 THERAPEUTIC POSSIBILITIES IN THE USE OF A CLOSED BETA-IRRADIATOR. A REPORT. Walther, Delia Z. Haut-Geschlechtskrankh., 39: 210-23(Sept. 1, 1965). (In German).

Treatment of precancerous skin conditions and basiliomas with β irradiators is advantageous because the entire dose can be administered in a single treatment, with a relatively wide latitude in dose. As much as twice the required dose can be administered without scar formation. For juvenile hemangiomas, 200 to 400 rep are administered in single doses over periods of up to 4 weeks. Naevi flammei can be treated with 1000 to 1500 rep given at intervals of 4 to 8 weeks. For planar warts a single irradiation with 2500 to 3000 rep is usually sufficient. For basiliomas, 6000 to 6400 rep is given in a single irradiation. Although the radiation reaction is more severe and appears sooner than after fractionated irradiation, the final effect is just as good. One advantage of fractionated irradiation treatment for facial defects is that the radiation reaction is considerably milder, though more lengthy. (BBB)

26547 USING THE SPARK CHAMBER FOR SEQUENTIAL IMAGING. Horwitz, N. H. (William Beaumont Hospital, Royal Oak, Mich.); Powsner, R. M.; Powsner, E. R. Nucleonics, 25: No. 4, 66-8(Apr. 1967).

The Spintharicon, a spark imaging camera for nuclear medicine, was used for sequential imaging of ^{131}Cs-labeled cesium chloride and cesium acetate distribution in the rat. Rapid uptake of the cesium chloride by the skeletal muscle was observed; a rather surprising finding was the concentration of ^{131}Cs in thyroid tissue. Cesium acetate uptake was greatest in the heart and liver. Sequential imaging of ^{125}I distribution in mice was also carried out. The sequential pictures that were obtained are presented in the text. (B.H.S.)

26548 RAPID BRAIN SCANNING WITH ^{99m}Tc. Harper, P. V.; Fink, R. A.; Charleston, D. B.; Beck, R. N.; Lathrop, K. A.; Evans, J. P. (Argonne Cancer Research Hospital, Ill.). Acta Radiol., Diagn., 5: 819-31(1966).

A new scanning system was designed and constructed, which provides a mechanical device permitting rapid and more efficient scanning, an optimized detector–collimator assembly to increase the detection sensitivity and resolution, and use of ^{99m}Tc-pertechnetate to reduce radiation dosage to the patient and to increase the available number of detectable photons. The brain scanner described was designed to produce simultaneous left and right lateral scans of conventional quality in as little as 90 sec. Scanning time is reduced by a factor of 4 by use of 4 scintillation detectors arranged in opposing pairs, which scan both sides of the patient's head simultaneously. The detectors were designed to accept interchangeable collimators which have maximum sensitivity for SP γ energies. Reduction of the radiation dose to the patient by choice of ^{99m}Tc is the greatest contribution by the present method. Technetium-99m has the additional advantage to the 6-hr half life that it produces no primary particle radiation so that the energy deposited in tissue is small. The daughter activity of ^{99m}Tc is ^{99}Tc, whose radioactivity is negligible, being 3.3×10^{-6} μCi/mCi of ^{99m}Tc destroyed. Technetium-99 decays by emitting a soft (0.29 MeV) β to stable ^{99}Ru. Human studies showed that one half of the injected ^{99m}Tc activity is excreted in the first 48 hr after intravenous administration. The radiation dose from the usual scanning dose of 10 to 12 mCi of ^{99m}Tc, assuming complete retention and uniform distribution, was estimated to be ~100 mrad to the total body, and ~3000 mrad to the stomach, the target organ. Scanning was begun 15 min after injection of the isotope, allowing time for equilibration between the intravascular and extravascular compartments. (BBB)

26549 COMBINED X-RAY AND γ-RADIUM RAY THERAPY FOR SKIN CANCER. Wooldridge, Wilfred E.; Lorenc, Ernest (Univ. of Missouri, Columbia). Arch. Dermatol., 95: 102-10 (Jan. 1967).

Complications, especially radionecrosis, encountered in treating 1146 skin cancers are reported. The combined superficial x-ray and Ra treatment was administered by 2 techniques, each resulting in a total tomor dose of 5500 to 6000 R. Some patients were not given the combined radiation treatment because the risk of radionecrosis was prohibitively high, either because of prior irradiation which precluded additional treatment, or because the amount of radiation previously given could not be determined. There were 34 occurrences of radionecrosis, an incidence of 2.96%. This complication became less frequent with perfection of the techniques. The locations of the radionecroses included 3 sites on the hand and one on the leg. It was concluded that it is hazardous to use cancericidal doses of radiation in these locations and no more patients in the last half of the series were treated with radiation on these sites. Time of occurrence of radionecrosis was less than 1 yr after treatment in 5 cases, 1 to 2 yr in 10, 2 to 3 yr in 10, 3 to 4 yr in 6, and >4 yr in 3. It is emphasized that a cancericidal dose of radiation to the skin, unless in the Grenz-ray range, carries a risk of radionecrosis. For this reason various treatment schedules have been devised, particularly protraction over many days. While this protraction has been of value in lessening the incidence of radionecroses, it may become too time-consuming. Methods for protection of the eye are described. A cure rate of 99.7% of skin cancers was obtained. (BBB)

26550 BRAGG PEAK PITUITARY DESTRUCTION FOR DIABETIC RETINOPATHY. Kjellberg, R. N.; Field, R. A.; McMeel, J. W.; Sweet, W. H. (Massachusetts General Hospital, Boston). pp 783-7 of Proc. Third Intern. Congr. Neurol. Surg., Aug. 23-7, 1965, Copenhagen. Amsterdam, Exerpta Medica Foundation, 1966.

The Bragg peak proton beam produced by a 160-MeV cyclotron was used to induce focal necrosis in the pituitary and consequent hypopituitarism to arrest hemmorrhagic retinopathy in 92 diabetic patients. The radiation technique, doses, clinical results, and complications of proton irradiation are described. A stereotactic instrument rigidly mounted to a frame along which the proton beam passes was used with a dose such that there was a 99% chance that the visual pathways received less than 2000 rad. The beam was set so that the anterior and interior walls of the sella received at least 10,000 rad. The posterior one-third of the sella was avoided to circumvent diabetes insipidus. The Bragg peaks of beams entering from opposing lateral directions were overlapped so that in this axis the pituitary fossa is exposed to nearly homogeneous doses of high intensity radiation. The beam was directed from 7 lateral portals on each side of the head, totaling 14 portals of entry, from 14° anterior to 28° posterior to the coronal plane through the pituitary fossa. A variable water absorber automatically adjusted to control the depth of penetration of each beam so that its Bragg peak was confined to the sella turcica. A histologic section from an irradiated pituitary is illustrated which shows widespread necrosis of the gland with a narrow border of apparently viable cells at the periphery of the gland. Headaches occurred in 77% of patients and over half experienced nausea and vomiting. Eleven patients developed symptomatic diplopia, but recovery occurred in 8. The frequency of even minor oculomotor symptoms, including ptosis, 40% in the early group, was improved to 25% with the current method. Diabetes insipidus occurred severely 3 times and mildly 4 times.

No cerebrospinal fluid leaks occurred. The described technique of using the Bragg peak protein beam produced pituitary suppression in 91%, arresting visual loss due to diabetic retinopathy in 71%. (BBB)

Radiation Effects on Animals

Refer also to abstracts 26331, 26340, 26348, 26397, 26400, 26486, 26490, 26525, 26549, and 26550.

26551 (ANL–7220, pp 48–51) PROLIFERATIVE CAPACITY OF STEM CELLS FROM THE MARROW OF ISOTOPICALLY LABELED BONE: PRELIMINARY EXPERIMENTS. Failla, Patricia McClement (Argonne National Lab., Ill.).

Techniques for measuring unirradiated marrow cell growth in spleens of x-irradiated (900 R) mice are reported. The experiments were preliminary to future studies in which the marrow will be surrounded by bone labeled with various radioactive elements such as: ^{226}Ra, ^{45}Ca, ^{90}Sr, ^{32}P, and ^{239}Pu. (H.G.D.)

26552 (BMwF-FBK–67-01) DER EINFLUSS EINER ROENTGENGANZKOERPERBESTRAHLUNG AUF DEN EINBAU VON 2-C^{14}-GLYCIN IN DIE PROTEINE DER LEBER, MILZ UND DES BLUTES VON RATTEN. **(The Incorporation of 2-^{14}C-Glycin into the Proteins of Liver, Spleen, and Blood of Rats After Whole Body Irradiation).** Hoelzel, F. (Hamburg Univ., Eppendorf (West Germany). Frauenklinik). Jan. 1967. 18p. (In German). Dep.

Whole-body x irradiation with 800 R was followed by a triple increase of the radioactivity in the liver and spleen proteins of rats injected with ^{14}C-glycine. The analysis of the radioactivity of the precursor pool showed an increase of ^{14}C-activity at the same degree as was found in the proteins. Thus, the increase of the incorporation rate of ^{14}C-glycine into the proteins is simulated, and consequently there is no change of the protein synthesis as measured with ^{14}C-glycine in liver and probably also in spleen of irradiated rats. (auth)

26553 (BMwF-FBK–67-16) DER EINFLUSS WEICHER ROENTGENSTRAHLEN AUF DIE REIZSCHWELLE DER NERVENFASER. **(The Influence of Soft X-Rays Upon the Stimulus Threshold of the Nerve Fiber).** Vanselow, K. (Kiel Univ. (West Germany). Institut fuer Angewandte Physik). Mar. 1967. 93p. (In German). Dep.

Extensive measurements of the variation of the electrical properties of nerve fibers during irradiation with soft x rays led to the conclusion that the variation of the resistance of the axon membrane and of the pores are induced by the electrostatic-mechanical forces at the axon membrane, the physical properties of which are changed under the influence of ionizing radiation. Theoretical relations are derived and the results are found to be in full agreement with the corresponding measurements. (51 references.) (auth)

26554 (BNWL–370) PACIFIC NORTHWEST LABORATORY MONTHLY ACTIVITIES REPORT, DECEMBER 1966 [ON] DIVISION OF BIOLOGY AND MEDICINE PROGRAMS. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Jan. 1967. Contract AT(45-1)-1830. 19p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

PLUTONIUM-239— distribution in rat tissues
CESIUM-137— metabolism in rats
ZINC-65— uptake by fish in Columbia River
LEUKEMIA— radioinduced in miniature swine, by chronically ingested strontium-90
NEOPLASMS— radioinduced in miniature swine, by chronically ingested strontium-90
PLUTONIUM NITRATES Pu(NO$_3$)$_4$— complexes with citrate, containing plutonium-239, effects of DTPA on removal from rat tissues.
PLUTONIUM-238— distribution in dog tissues of, from inhaled microspheres of plutonium oxide
BEETLES— ecology of darkling, at Hanford Area, effects of elevation on
CESIUM-137— content in Alaskan Eskimos, 1967, whole-body
COLUMBIA RIVER— radioactivity in, 1966 and 1967, effects of reactor shutdown on
GROUND WATERS— flow systems of Hanford Area
COMPUTER PROGRAMS— STREAM, for data analysis on ground water flow
RICHLAND AREA (WASH.)— geology of
RICHLAND AREA (WASH.)— aerial surveying of, using infrared imaging equipment to determine thermal distribution over land water areas
FALLOUT— distribution in atmosphere of, mechanisms for
ATMOSPHERIC PRECIPITATION— analysis of, for cosmic ray produced radionuclides
FALLOUT— analysis for ratio of barium-140 to cesium-136 in, for distinction between plutonium-239 and uranium-235 detonations
CALCIUM— content in man, determination of, by whole-body measurement of neutron-activated cadavers
TELEMETERING SYSTEMS— use for monitoring physiological functions in experimental animals. (C.H.)

26555 (BNWL-SA–1143) EFFECT OF BILE ON THE MUCOSA OF THE SMALL INTESTINE. Mahony, T. D.; Berlin, J. D.; Pekas, J. C.; Sullivan, M. F. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). [1966]. Contract AT (45-1)-1830. 13p. (CONF-660917–7). Dep. CFSTI.

From Gastronintestinal Radiation Injury Symposium, Richland, Wash.

In the non-irradiated rat and pig the lack of bile results in morphological changes in the appearance of the intestinal mucosa with an apparent increase in the number of goblet cells. An increase in number and size of goblet cells in x-irradiated bile fistula animals was confirmed. With the electron microscope we were unable to detect differences in the luminal surfaces of goblet cells from bile fistula rats and rats with an intact biliary system, that would suggest a mechanism by which bile increases mucus depletion. We did note an increase in thickness of the surface mucopolysaccharide coat after both bile fistula and irradiation. Culturing the intestinal contents of normal, surgical control, bile duct cannulated, and/or irradiated rats demonstrated an increased coliform count in the small intestine following either bile diversion or irradiation. This may be another means by which goblet cells are increased in the mucosa of bile duct cannulated animals. Disease states have been cited in which bile salts are present in abnormal quantities or forms which might result in mucosal changes such as were produced experimentally in these studies. (auth)

26556 (NP–16630) DE INVLOED VAN ROENTGENSTRALING OP DE DELINGSCYCLUS VAN IN VITRO GEKWEEKTE CELLEN. **(The Influence of X-Rays on the Reproduction Cycle of Cells Cultivated In Vitro).** Bootsma, Dirk (Leiden Rijksuniversiteir (Netherlands)). June 23, 1965. 80p. (In Dutch). Dep. mn. Thesis.

The influence of a 200 R x irradiation on the first postirradiation generation cycle of human cells in tissue cultures (T-cells) was studied, these investigations were carried out with exponentially multiplying cells in monolayer cultures and with cultures that were synchronized. By labeling cells with ^{3}H-thymidine for 20 min, it was shown that the generation cycle of the T-cell could be subdivided into four phases based on the occurrence of DNA synthesis. A short blockade at the end of G$_2$ and a partial synchronization in the G$_1$ phase were observed, but these disturbances have no obvious influence on the analysis of the generation cycle based on pulse labeling experiments. By isolating sublines from the same parent line, it was possible to compare the generation cycle of related cell lines. Differences in the average duration of these cycles were mainly caused by differences in the duration of the G$_1$ phase, and slight differences in duration of the G$_2$ phase were also observed. The synchronization procedure was based on blocking DNA synthesis for 24 hours by excess thymidine. The influence of irradiation in the various phases of interphase on the entrance of cells into mitosis was studied in synchronous cultures by irradiation at different time intervals after a second treatment with thymidine followed by an analysis of the mitotic activity. The same problem was also investigated with asynchronous cultures. The results showed that mitotic delay is caused by an inhibition of progression in the G$_2$ phase. Cells irradiated in the G$_2$ phase were found to be blocked for long periods. Cells in the S phase also have a lengthening of the S phase, but the total delay of these cells was less than that of irradiated G$_2$-phase cells. Cells irradiated during G$_1$ were unaffected or only very slightly affected. These differences in the degree of mitotic activity incurred by cells irradiated in various phases of the interphase bring about partial synchronization leading to overshoot of the mitotic index. Related T-cell lines, which showed differences in duration of the generation cycle, also differed in the duration of mitotic delay with cells with a longest generation cycle having the longest delay. (tr-auth)

26557 (NYO–1680-1) PROGRESS REPORT ON RADIATION EFFECTS ON SMALL BLOOD VESSELS AND RELATED ORGANS. Final Report, October 1953–May 1964. (New York Univ., N. Y.). June 1964. Contract AT(30-1)-1680. 39p. Dep. CFSTI.

X RADIATION— effects on blood pressure of rats, whole-body
RATS— radiation effects on blood pressure of, whole-body x
BLOOD PRESSURE— radiation effects on, in rats, whole-body x
RATS— radiation effects on response to trauma of, whole-body x
X RADIATION— effects on response to trauma of rats, whole-body

INJURIES—radiation effects on response to shock of, in rats, whole-body x
SHOCK—radiation effects on response to traumatic, of rats, whole-body x
IMMUNE REACTIONS—radiation effects on, in rats, whole-body x
X RADIATION—effects on immune reactions in rats, whole-body
RATS—radiation effects on immune reactions in, whole-body x
RETICULO-ENDOTHELIAL SYSTEM—radiation effects on phagocytic activity of, in rats, whole-body x
RATS—radiation effects on phagocytic activity of reticulo-endothelial system of, whole body x
X RADIATION—effects on phagocytic activity of reticulo-endothelial systems of rats, whole-body
HEMORRHAGE—radioinduced in rats, mechanisms for whole-body x
RATS—radioinduced hemorrhage in, mechanisms for whole-body x
X RADIATION—effects on blood vessels in rats, mechanisms for hemorrhage induced by whole-body
BLOOD VESSELS—radiation effects on permeability of, in rats, effects of calcium, steroids, and 5-hydroxytryptamine on x
STEROIDS—effects on capillary permeability in x-irradiated rats
INDOL-5-OL—3-(2-aminoethyl)-, effects on capillary permeability in x-irradiated rats
CALCIUM—effects on capillary permeability in x-irradiated rats
HISTAMINE—effects on capillary permeability in x-irradiated rats
NITROGEN MUSTARDS—effects on capillary permeability in rats
BLOOD VESSELS—effects of nitrogen mustard on permeability of rat
BLOOD VESSELS—radiation effects on response to constrictor drugs of, in rats, whole-body x
RATS—radiation effects on response of blood vessels of, to drugs, whole-body x
X RADIATION—effects on capillary permeability in rats, whole-body
X RADIATION—effects on response of rat blood vessels to drugs, whole-body
TOXINS—radiation effects on response of rats to, whole-body x
RATS—radiation effects on response to toxins of, whole-body x
X RADIATION—effects on response of rats to toxins, whole-body
HEMATOPOIETIC SYSTEM—radiation effects on dehydrogenase activity of rat, whole-body x
X RADIATION—effects on dehydrogenase activity in hematopoietic tissues of rats, whole-body
RATS—radiation effects on dehydrogenase activity in hematopoietic tissues of, x
OXIDOREDUCTASES—radiation effects on activity of, in rat hematopoietic tissues, whole-body x
FETUSES—radiation effects on development of rat, whole-body x
RATS—radiation effects on development of fetal, whole-body x
X RADIATION—effects on development of rat fetuses, whole-body
DRUGS—radiation effects on response of rats to blood vessel constrictor, whole-body x. (C.H.)

26558 (NYO-1800-20) ATTEMPTS TO DELINEATE INBORN ANEMIAS IN MICE. Progress Report, February 1, 1966–January 30, 1967. Russell, Elizabeth S.; Bernstein, Seldon E. (Jackson Lab., Bar Harbor, Maine). Contract AT(30-1)-1800. 22p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Progress is reported on delineation of inborn anemias of laboratory mice. A twelfth anemic condition, normoblastosis, was added to the list. Since each of the anemias is brought about by substitution of a deleterious allele(s) at a difference genetic locus, it is concluded that there are at least 12 different internal physiological processes that are important for erythrocyte production, maintenance, or both. Studies were conducted to increase understanding of normal and abnormal hemopoiesis by investigating the action of the anemia-producing genes. (H.G.D.)

26559 (ORNL-TM-1715) SYNERGISTIC EFFECT OF ZERO-G AND RADIATION ON WHITE BLOOD CELLS AND NEUROSPORA SPORES. Annual Report [for] Period Ending June 30, 1966. (Oak Ridge National Lab., Tenn.). Mar. 1967. Contract W-7405-eng-26. 28p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

LEUKOCYTES—radioinduced chromosome aberrations in samples of, effects of acceleration, vibration, and zero gravity on β and x
FUNGI—radioinduced chromosome aberrations in Neurospora spores, effects of acceleration, vibration, and zero gravity on β and x
SPACE FLIGHT—effects of conditions of, on radioinduced chromosome aberrations of leukocytes and Neurospora spores
BETA PARTICLES, X RADIATION—effects on induction of chromosome aberrations in leukocytes, combined effects of acceleration, vibration, and zero gravity with
BETA PARTICLES, X RADIATION—effects on induction of chromosome aberrations in Neurospora spores, combined effects of acceleration, vibration, and zero gravity with
PACKAGING—design for biological materials during space flights (C.H.)

26560 (ORO-2978-17) [RADIATION EFFECTS]. Final Report. Dent, J. N. (Virginia Univ., Charlottesville). Nov. 25, 1966. Contract AT(40-1)-2978. 9p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Results are reported on attempts to produce radiation chimeras between frogs and salamanders, using *Rana pipiens* and *Triturus viridescens* exposed to various doses of x radiation. Although a wide variety of hemopoietic grafts were made, none were effective in increasing the life span of lethally irradiated amphibian hosts. Data are included from studies on the effects of various doses of x radiation on the inhibition of regeneration of salamander limbs previously exposed to doses of 2,500 to 5,000 R x radiation; the effects of adrenal hormones on regeneration of salamander limbs; the cytology of the pituitary gland of the spotted eastern newt during various developmental stages; and the effects of uv and visible light on the viscosity of deoxyribonucleoprotein extracted from chick embryos. (C.H.)

26561 (RLO-1780-22) EFFECTS OF IONIZING RADIATION ON THE TESTICULAR FUNCTION OF MAN. Fourth Yearly Progress Report, June 1, 1966–May 31, 1967. Heller, Carl G. (Pacific Northwest Research Foundation, Seattle, Wash.). Mar. 1967. Contract AT(45-1)-1780. 52p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

MAN—radiation effects on function of testes of, effects of dose fractionation and total dose of x
GONADS—radiation effects on function of male, in man, effects of dose fractionation and total dose of x
EPITHELIUM—radiation effects on physiology of, male gonads, effects of dose of x
X RADIATION—effects on physiology of testes of man, effects of dose fractionation and total dose
PHYSIOLOGY—radiation effects on, of testes in man, x
PITUITARY HORMONES—radiation effects on secretion of, in man, effects of exposure of testes to various doses of x
ADRENAL HORMONES—radiation effects on secretion of, in man, effects of exposure of testes to various doses of x
TESTOSTERONE—radiation effects on metabolism of, in man, effects of dose to testes exposed to x
URINE—excretion of estrogens in, of man
SPERM—radiation effects on morphology of, effects of dose of x
SPERMATOGENESIS—radiation effects on, in man, effects of dose to testes exposed to x
X RADIATION—effects on spermatogenesis in man, effects of dose to testes on
MAN—radiation effects on spermatogenesis in, effects of dose to testes of x
GONADS—radiation effects on morphology of, in man, effects of dose to testes of x
CHROMOSOMES—radioinduced aberrations of, in testes of man, effects of dose of x
X RADIATION—effects on chromosome aberration induction in testes of man, effects of dose on (C.H.)

26562 (UR-49-748) BRIEF DESCRIPTION OF RESEARCH PUBLISHED OR ACCEPTED FOR PUBLICATION DURING 1966. Annual Report. Neuman, William F.; Rothstein, Aser (Rochester Univ., N. Y. Atomic Energy Project). Apr. 1, 1967. Contract W-7401-eng-49. 253p. Dep. CFSTI.

Summaries and conclusions of 142 published papers are presented. The papers are listed under the following subject categories: Radiation Effects- General; Toxicity of Radioelements; Molecular and Cellular Level Studies; Radiological and Health Physics and Instrumentation; Chemical Toxicity; and Cancer Research. (H.L.W.)

26563 (AD-636585) REACTIVITY OF ADRENERGIC AND CHOLINERGIC RECEPTORS IN ACUTE RADIATION. Danysz, Andrzej. Translated from Roczniki Akad. Med. Bialynistoku, Suppl. 6, 1-84(1961). 106p. (FTD-TT-65-941). CFSTI.

Results are reported from studies on disturbances in the function of the nervous system in cats, guinea pigs, and mice exposed to x radiation. In acute radiation sickness provoked by irradiation with x rays in sublethal doses, sensitivity of adrenergic receptors in relation to catecholamines was enhanced, specifically so at the peak of the illness, while generally the inhibiting action of monoaminooxydases was diminished. Likewise, the level of adrenaline in the adrenals was lowered. As a rule, sensitivity of cholinergic receptors in relation to parasympathicotonic drugs was attenuated, particularly so in isolated organs, acting both directly and indirectly. This refers to acute radiation sickness with a nonlethal process in the period of intensified clinical manifestations. Concurrently, sensitivity of these receptors was enhanced in relation to parasympathicolytic drugs. The lowered activity of choline esterase was the corollary of sensitivity variations in receptors. (139 references.) (auth)

26564 (TT-65-50409/4) ARCHIVES OF BIOLOGICAL SCIENCES. Translated from Arh. Biol. Nauka (Belgrade), 17: 209-98; 19P-32P(1965). 124p. CFSTI.

Eight papers were translated: a separate abstract was prepared for NSA on one paper that was concerned with the inhibition of the primary immune response in rats irradiated with 1580 R x-ray doses under conditions of combined hypothermia and hypoxia. Other papers were presented on: maintenance of endocrine glands in vitro; preparation of giant axons of cephalopods for optical experiments; movement of chiasmata in supernumerary chromosomes of corn; phosphorus in the water and mud of Lake Dojran; development of Trapa longicarpa; and variability of the hornbeam (Carpinus betulus L.). A bibliography of approximately 145 papers published during the previous year on cytology, histology, anatomy, morphology, genetics, ecology, microbiology and parasitology, biogeography and taxonomy, paleontology, and evolution is included. (H.G.D.)

For an abstract of the individual paper see: 26565.

26565 (TT-65-50409/4, pp 19-26) INHIBITION OF THE PRIMARY IMMUNE RESPONSE IN RATS IRRADIATED WITH 1580 r DOSE, COMBINED WITH HYPOTHERMIC-HYPOXIC PROTECTION. Rajevski, Olivera; Rajevski, V. E. Translated from Arh. Biol. Nauka (Belgrade), 17: 225-33(1965).

The production of immune hemagglutinins was examined in rats x-irradiated with 1580 R under conditions of combined hypothermia and hypoxia. Results showed that 1580 R irradiation under hypothermia combined with asphyxia leads to a strong inhibition of the immune response that is most evident during the first days postirradiation. Inhibition was greatest in animals immunized on the 3rd day postirradiation. In comparison with the immune response of controls, the latent period was extended from 3 to 17.8 days, while the mean log of the maximum titer was reduced from 2.318 to 0.648, and the presence of hemagglutinins was not detectable in the blood of 46% of the animals. The hypothermia-asphyxia treatment modified the immune response in unirradiated controls immunized three days later. For these animals the latent period was extended to 4.3 days, the mean log of the maximum titer was somewhat lower (2.140), the titer decline between the 7th and 14th days was significantly faster, and a secondary rise in antibody production was noted about the 20th day after immunization. (H.G.D.)

26566 MICROCINEMATOGRAPHIC RESEARCH ON THE MORPHOGENESIS OF MICRO-ERYTHROBLASTS UNDER THE EFFECTS OF X RAYS. Rondanelli, E. G.; Trenta, A.; Magliulo, E.; Vannini, V.; Gerna, G. (Univ., Pavia, Italy). Pathol. Biol. Sem. Hop., 13: 735-42(Aug.-Sept. 1965). (In French).

Phase-contrast studies were made of cultured hematopoietic cells of the salamander, Triton molge vulgaris, submitted to low doses (12 R) of x rays. Mitotic anomalies were observed in hypoploid microerythroblasts (mononucleated erythropoietic microcells), and these were examined by microcinematography. In metaphase, a few chromosomes were seen to become isolated from the equatorial plate and form a micronucleus which is then expelled from the cell. A second type of hypoploid microerythroblast occurred in bipluripolar anaphase, wherein a marked asymmetry in the distribution of chromatids resulted in formation of a microcell. A third type change was seen in irradiated cells which resulted in tripluricentric mataphase or tripluripolar anaphase with symmetric distribution of chromosomes to form microcells. Possible means whereby x rays can affect the mitotic apparatus of the cell to cause such abnormal mitoses and consequent formation of hypoploid microerythroblasts are discussed. (BBB)

26567 THE INFLUENCE OF MASSIVE DOSE IRRADIATION OF ^{60}Co TO THE MAMMAL. 1ST REPORT. ON THE MACROSCOPIC OBSERVATIONS OF CLINICAL SYMPTOMS. Kurosawa, Hiroshi; Moriya, Hiroshi (Toho Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 26: 454-7(Aug. 1966). (In Japanese).

Studies were made to investigate the influence of a massive gamma radiation dose on mammals. Guinea pigs were exposed to whole-body cobalt-60 irradiation. A study was made of the effect of the source-skin distance. A total dose of 10,000 R was administered. Results show that cerebral symptoms and cramp appeared within 15 to 20 min in all cases following irradiation. The red and white blood count decreased after 8 hrs, as did the blood platelets and lymphocytes. (TSS)

26568 STUDIES ON THE IRRADIATION EFFECTS ON THE CELLS. 7. PHASE MICROSCOPICAL STUDIES OF THE INITIAL RADIATION EFFECTS ON NORMAL AND NEOPLASTIC CELLS. Katayama, Eitaro (Tokushima Univ., Japan). Tokushima J. Exp. Med., 12: No. 2, 88-99(Aug. 1965).

Results are reported from studies on the initial effects of radiation on Ehrlich ascites tumor cells and in vitro lung cells exposed to doses ranging from 300 to 3,000 R. Observations on cells examined under a phase microscope are described. (TSS)

26569 RETINAL LASER PHOTOCOAGULATION. Zweng, H. Christian (Stanford Univ., Palo Alto, Calif.). Trans. Pac. Coast Oto-ophthalmol. Soc., 45: 423-38(1964).

Effects of ruby laser radiation on the eyes of the rabbit, cat, monkey, and human were studied in the course of developing a retinal photocoagulator. The effects were studied by examination of the retina with the ophthalmoscope, retinal photography, and histological examination of 40 enucleated eyes. In the animal eyes the ophthalmoscopic appearance of the burns produced by the laser varied, with the amount of laser energy delivered and with the degree of pigmentation of the pigmented epithelium of the retina and of the choroid. The lesions obtained at energies just above laser threshold were barely visible with the direct ophthalmoscope as whitish areas, measuring 0.2 mm in dia. When the energy was increased up to 0.08 J, lesions became larger, measuring 0.5 to 0.8 mm in dia, and were highly structural. They contained a central charred point surrounded by a larger pale area with a thin pigment rim, which, in turn, was surrounded by an orange-colored halo (grade 1 lesions). With more than 0.08 J, vapor bubbles were noted in the retina and in the vitreous directly above the lesion (grade 2 lesions). With greater energies, retinal hemorrhages and holes developed instantly. These hemorrhages ranged from a fleck of blood in the center of the lesion (grade 3 lesion) to large hemorrhages which escaped into the vitreous humor. Even with energies that produced large retinal tears (grade 4 lesions) the hemorrhages produced never completely obscured the fundus. Sections of rabbit and monkey eyes showed the retina and superficial choroidal structures to be deranged and scarred, with the formation of a chorioretinal adhesion. Retinal lesions, varying from 0.1 to 0.25-mm in dia, were produced in human eyes. (BBB)

26570 LASER ACTION ON THE HUMAN EYE. Tengroth, B.; Karlberg, B.; Bergqvist, T.; Adelhed, T. (Research Inst. of National Defence, Stockholm). Acta Ophthalmol., 41: 595-603 (1963).

The action of ruby laser pulses of wavelength 6943 Å was studied on a normal human eye and on an eye with macular degeneration. In the first case laser irradiation of the eye produced sharply defined retinal burns, because the optical system of the eye focussed the pulses on the retina. The laser pulses produced no dazzling phenomena but rather a small green after-image which persisted for about half an hour. The after-image the patient saw agreed with experience of persons who had witnessed an atomic bomb explosion or looked at an eclipse of the sun. Biomicroscopy revealed a minute flare and, with the ophthalmoscope, burn lesions centrally in the eyeground were found. Examination of the enucleated eye disclosed no signs of burns on the sclera either externally or internally opposite the foveal region. After laser stimuli the electroretinogram showed a positive component (b-wave) which was not preceded by a distinct negative component (a-wave). The appearance of the white light electroretinogram was not affected by laser stimulation. The amplitude and duration of the b-wave response to laser stimulation were 200 μv and 70 msec, the corresponding figures for white light stimulation being 135 μv and 135 msec. The laser pulse had a dia of 5.7 mm and a power of 0.2 W for 0.5 msec, with a total energy content of about 0.012 cal. It was assumed that about 70% of this was absorbed by the pigment epithelium and choroid at the 0.07 mm^2 spot at which the pulse was focused. This represented an effect of about 24,000 cal/cm^2/sec, that was considered to be more than sufficient for production of a retinal burn. (BBB)

26571 LASER RADIATION: SOME SPECIFIC DENTAL EFFECTS AND AN EVALUATION OF ITS POTENTIAL IN DENTISTRY. Peck, Sheldon; Peck, Harvey (Boston Univ.). J. Prosth. Dent., 17: 195-203(Feb. 1967).

The observable effects of pulsed ruby laser radiation on enamel and dentin are described. Extracted noncarious maxillary incisors irradiated with a focused, pulsed ruby laser with a 2000-J power supply were examined grossly and microscopically. Enamel exhibited gross cratering from 0.1 to 1.1 mm deep, depending on the amount of energy delivered to the target area. In dentin-deep enamel penetrations, a dark speckling of the exposed dentin subjacent to the lased enamel was observed. Examination under polarized light suggested the presence of laser-induced crystallographic changes in the enamel bordering the enamel craters. Dentin laser impacts yielded shallow, irregular craters less than 0.1 mm deep. Three distinct zones of dentinal destruction were revealed: a central zone of complete dentinal destruction, an immediate surrounding zone of partial dentinal destruction, and a scattered zone of dark speckling beyond the first two zones. Laser-treated Ivorine demonstrated the mildest effect, showing only surface irregularities. Suggestions are presented for possible future dental applications of the laser. (BBB)

26572 ROLE OF THE PITUITARY BODY IN THE REACTION OF THE ADRENAL CORTEX TO IRRADIATION. Patalova, V. N. (Inst. of Experimental Medicine, Leningrad). Byull. Eksp. Biol. Med., 62: No. 8, 27-30(Aug. 1966). (In Russian).

Six hypophysectomized dogs and one control dog were exposed to chronic radiation in a chronic experiment. Function of the adrenal cortex was studied in hypophysectomized dogs during irradiation. The function of the adrenal cortex was determined by the content of 17-oxycorticosteroids and eosinophils in the peripheral blood. In part of the animals the reactions of the adrenal cortex caused by the electrical stimulation of the subcortical regions of the brain were investigated. It was found that irradiation was responsible for an increase in the 17-oxycorticosteroids content of the blood in hypophysectomized dogs. As distinct from dogs with an intact hypophysis in which hormonal changes are of a phasic character, in irradiated hypophysectomized animals the increase in the blood steroids concentration persisted for a long time, sometimes until death. At the same time, irradiated hypophysectomized dogs manifested the same changes in the content of hormones in response to stimulation of the subcortical region as in animals with an intact hypophysis, which apparently points to the existence of a common mechanism of their origination in hypophysectomized and intact animals. The experiments testify to the fact that in changes of the adrenal cortex in irradiation an important role is played by disturbances in the central nervous system. (auth)

26573 APPEARANCE OF THYROGLOBULIN AUTOANTIBODIES AFTER EXPOSURE OF NORMAL HUMAN THYROIDS TO SURGERY AND IONIZING RADIATION. Godal, Tore; Berdal, Peter (Univ. of Oslo). Acta Pathol. Microbiol. Scand., 69: 63-70(1967).

Thyroglobulin autoantibodies were rarely detected in patients without thyroid disease whose thyroid had been exposed to x rays and/or surgery. Of 54 patients, suffering mainly from laryngeal cancers, thyroglobulin autoantibodies were demonstrated in 3 patients (5.6%) after x irradiation of the thyroid gland with a tissue dose of 3400 to 6200 R. Among 34 patients with glands exposed to surgical injury or surgery and x rays, two (5.9%) were found to have thyroglobulin autoantibodies. One patient out of 36 (2.8%) revealed thyroglobulin autoantibodies prior to any treatment. In one out of 25 patients a negative reaction previous to treatment was followed by a positive reaction after treatment; the patient was found to have an infiltration of the thyroid from a tracheal squamous cell carcinoma. Since thyroglobulin apparently gained entrance to the circulation following thyroid injuries of the kinds studied, the results did not support the leakage theory of thyroglobulin autoantibody formation. (BBB)

26574 THE FORMATION OF CALLUS IN OFFSPRING FROM CHRONICALLY IRRADIATED ANIMALS. Dokuchaeva, N. F. Byull. Eksp. Biol. Med., 62: No. 8, 98-100(Aug. 1966). (In Russian).

Male and female rabbits were exposed to x rays in daily doses of 5 to 10 R to a total dose of 300 R during 1½ to 2 months. A study was made on healing of fractures in 34 rabbits belonging to the first generation of offspring from irradiated parents. Part of them were born 34 to 36 days after the termination of irradiation, others at three months, still others after one year. At the age of three months, the second metatarsal bone was fractured in experimental and control animals. In the control group of rabbits, healing usually began by the 45th to 60th day after fracturing. In rabbits borne of irradiated parents the formation of callus was distorted, slowed-down and in the majority of cases no consolidation of fracture took place in general, and the process ended in the formation of a false joint. (tr-auth)

26575 EFFECTS OF PULSED LASER IRRADIATION OF THE FOREHEAD IN MICE. Fine, S. (Northeastern Univ., Boston); Klein, E. Life Sci., 3: 199-207(Jan. 1964).

Exposure of soft tissues to pulsed laser radiation indicated that effects were transmitted to structures distant from the site of impact through shock waves, and induced a secondary effect. Damage to the brain as the result of such secondary effects was investigated with a pulsed ruby laser at an energy output of 100 J in 1-msec. Of the 41 mice irradiated, 31 died within 24 hr. Nonfocused radiation was followed by death within less than 30 sec in 10 out of 23 animals. Focused radiation caused death within less than 30 sec in 2 out of 18 animals. Following irradiation the sensory status of surviving animals varied from deep coma (including absence of responses to pain or corneal irritation) to hyperesthesia. Intracranial hemorrhages were present at post-mortem, and in several instances hemorrhages from the mouth, nose, and auditory meatus into the orbit or retro-orbital space occurred. Gross intracranial hemorrhages were present in the meningeal spaces, in the ventricles and conducting system, and within the substance of the brain. The skin covering the forehead was superficially injured after nonfocused irradiation. Focused radiation produced lesions with a central area of necrosis (3 mm dia) surrounded by a circular area that showed a decrease in the degree of damage towards the periphery. From the center outward this circular ring showed vesiculation, edema, and hyperemia. The skin was not separated from the underlying frontalis muscle. The deep aspect of the frontalis showed petechial hemorrhages. In some specimens subperiosteal petechiae were present on the outer table of the cranial bones. Gross damage to the underlying bone, however, was not evident. The dura mater appeared intact upon removal of the cranial vault. These results indicated that the secondary effects of laser radiation were more severe at a deeper level than those produced in the tissues at the site of impact. The intracranial lesions were thought to be due to the transmission of the shock wave (mechanical and/or acoustic in origin) that was produced by the interaction of the radiation with the tissues. The force may have been generated by expansion of volatilized material contained deep within interfaces under the skin. (TSS)

26576 SOME PHYSIOLOGICAL EFFECTS OF MEASURED AIR IONS. Bachman, C. H.; McDonald, R. D.; Lorenz, P. J. (Syracuse Univ., N. Y.). Int. J. Biometeorol., 9: 127-39(Oct. 1965).

The effect of ions generated in air by β radiation from a ^{85}Kr source is reported. An apparatus constructed for the generation and administration of measured air ion doses is described. Experiments were performed on rats in which only the nostrils were exposed to the ionized air. Measurement of total ion current and of the electrical current to ground through the animal provided knowledge of the actual ion dose. Initial experiments indicated that both positive and negative air ion treatments tended to stimulate heartbeat and respiratory frequencies. However, the ion dose per rat was subject to individual variability. The most striking result was that 30-min exposure to both positive and negative ions tended to partially counteract the effects of anesthesia on heart and respiratory rates. In general, ions of either polarity changed the heartbeat and respiration frequencies of these rats in the same direction, i.e., they were comparatively stimulating; initially, negative ions tended to depress the change in respiratory rate. The action of air ions on respiration that occurred almost immediately upon exposure preceded significant changes in heartbeat frequency. However, 5 min after termination of exposure, both physiologic factors still demonstrated air effects. (BBB)

26577 CONCERNING THE DETERMINATION OF THE SKELETON ABSORPTION OF β-RAYS ENERGY OF SOME ISOTOPES IN EXPERIMENTAL CARCINOGENESIS. Malinina, N. K.; Ponikarov, V. I.; Popov, D. K. (Inst. of Radiation Hygiene, Leningrad). Vop. Onkol., 13: 56-9(1967). (In Russian).

The values of the absorption coefficients of some β-emitting isotopes were calculated theoretically and some of them checked experimentally. The use of the coefficients in calculating the doses for bone tissues from radioactive isotopes incorporated into the latter enabled construction of a single dose—effect curve for: ^{32}P, ^{45}Ca, ^{89}Sr, ^{90}Sr, ^{90}Y, ^{91}Y, ^{140}Ba, ^{144}Ce, and ^{147}Pm. The analysis of the dose effect curve shows that the energy absorbed in skeleton affects the process of the osteosarcoma formation, while the energy absorbed beyond the limits of bone tissues renders no effect on the process of tumor formation. (auth)

26578 HEAT-DAMAGE TO THE RETINA BY LASERS AND PHOTOCOAGULATORS. Vos, J. J. (Inst. of Perception RVO-TNO, Soesterberg, Netherlands). Ophthalmologica, 151: 652-4 (1966).

Since radiation injuries occur in the eye from accidental observation of laser radiation beams, nuclear explosion fireballs, and photocoagulator radiation beams, an attempt to establish the difference between harmful and harmless laser radiation doses from a review of data in published literature, was made. Opthalmoscopic examination of laser irradiated fundi was found to be the primary criterion used; therefore results of previous studies were analyzed in terms of retinal temperatures. Since threshold data did not coincide with an explanation based upon one critical temperature above which a lesion developed, a better description of the experimental results was obtained by assuming that the temperature had locally exceeded 100°C and that the visible lesion was the result of steam explosions on a micro scale. Improved technology in the use of laser light has enabled investigation of retinal burns in very short irradiation times or 1×10^{-8} sec. It was noted that laser radiation heat did not seem to pass the receptor of the retinal layers after a 200 μsec irradiation period; this was found to be contrary to that which happened at longer periods of irradiation. (TSS)

26579 SUNLIGHT AND SKIN. III. DEGENERATIVE AND NEOPLASTIC EFFECTS. **Honeycutt, W. Mage; Dillaha, Calvin J.; Jansen, G. Thomas (Univ. of Arkansas, Little Rock). J. Arkansas Med. Soc., 63: 112-24(Aug. 1966).**

Degenerative and neoplastic changes of the skin induced by chronic exposure to uv light are reviewed. The effect of irradiation with uv is cumulative in the skin, much the same as with x rays. Though the irradiated area appears to recover completely after a sunburn, there is residual damage which is added to with each succeeding exposure, until clinical abnormality is noted. The mechanism by which uv induces these changes is probably similar to that of x rays. Histological examination of chronically uv-exposed skin reveals thinning of the epidermis and flattening of the rete ridges which accounts for the clinical appearance of thinness and translucency. However, the most important changes are in the dermis. The collagen in the upper dermis is partially homogenized, lacks the fibrous appearance of normal collagen, and dilated vessels are numerous. Below this may be seen disoriented and fractured elastic fibers. Neoplastic changes that may be attributed to chronic uv exposure are actinic keratoses, basal cell epitheliomas, cutaneous horns, and squamous cell carcinomas. Prevention and treatment of uv-induced skin changes are discussed. (BBB)

26580 ACTION SPECTRA IN HUMAN SKIN. **Magnus, I. A. (St. John's Hospital for Diseases of the Skin, London). pp 144-8 of Progress in Photobiology. Christensen, B. Chr.; Buchmann, B. (eds.). Amsterdam, Elsevier, 1961.**

There is only one well-attested action spectrum for the effect of light on the human skin, that of the normal sunburn or the erythemal reaction resulting from uv, obtained by the emission of the mercury vapor or hydrogen arc as the light source for a monochromator. There is one maximum at about 300 mμ, just within the range of terrestrial sunlight, where the threshold dose is of the order of 10^5 erg/cm^2. Another maximum is at about 250 mμ. The erythemal effects of uv above 320 mμ are relatively feeble and not so well known; below 230 mμ nothing about the effects is known until the x-ray region is reached. Another effect of uv is a change in pigmentation; this may be either immediate or delayed. Immediate or so-called direct pigmentation, also known as pigment darkening, is not preceded by erythema, it is apparent immediately after irradiation and it persists for only a few hours or days. The action spectrum is between 300 and 450 mμ. The peak of the action spectrum is reported to be at about 340 mμ, where a dose of the order of 10^8 erg/cm^2 is required. The much more familiar delayed type of pigmentation shows up a day or so after sunburn response, is apparently a posterythemal effect, and persists for many weeks or months. It is due to the formation of new melanin. Although much is known about the biochemistry of melanogenesis, its uv action spectrum has not been properly defined. Another response of the skin to uv is thickening of the horny layer of the epidermis. Again, its action spectrum is not accurately known; like melanin, it is similar to that for sunburn. Pathological action spectra of patients with photosensitivity disorders are also discussed. (BBB)

26581 LASER EFFECT IN VITRO ENAMEL PERMEABILITY AND SOLUBILITY. **Stern, Ralph H.; Sognnaes, Reidar F.; Goodman, Fredric (Univ. of California, Los Angeles). J. Amer. Dent. Ass., 73: 838-43(Oct. 1966).**

Extracted human teeth with intact enamel were exposed to laser beams (12.0-J energy and a duration time of 500 μsec). Microradiographic examination of normal enamel surfaces showed demineralization in acid solutions, while the enamel that had been exposed to the laser beam showed less intensive subsurface demineralization. Measurement of the concentrations of calcium and phosphorus in the buffer solutions used to dissolve enamel surfaces showed no significant alteration in solubility produced by laser beam exposure. A section of unlased enamel before and after acid dissolution showed that the perikymata were virtually eliminated by the procedure. These observations indicated that the effect of laser radiation on enamel, whether manifested by surface glazing or crater formation, reflected itself in less subsurface demineralization when compared with untreated, intact enamel. Whether this effect was a purely physical one that rendered enamel a more amorphous substance by fusion of certain preformed pathways or whether there were certain chemical reactions caused indirectly by the effect of laser radiation remained to be determined. (BBB)

26582 EPIDEMIOLOGICAL STUDIES OF THE LEUKEMOGENIC EFFECTS OF RADIATION. **Lilienfeld, Abraham M. (Johns Hopkins Univ., Baltimore). Yale J. Biol. Med., 39: 143-64(Dec. 1966).**

Epidemiological studies of the leukemogenic effects of radiation conducted among atomic bomb survivors in Japan, radiologists, and in groups exposed medically to radiation are reviewed. Data from the Atomic Bomb Casualty Commission show an increase in the incidence of leukemia in exposed groups that was maintained for the 15 to 20 year period following actual exposure. The marked increase in Japan was related to dose. In other studies higher risks of leukemia were associated with pre-conception exposure of parents, intra-uterine irradiation, and postnatal irradiation. In comparisons of the mortality experience of members of a radiological society with that of the members of other specialty societies, it was clearly evident that the radiologists experienced a higher mortality rate with respect to all causes of death, and the incidence of leukemia was 2½ times higher than that in a group of ophthalmologists. (H.G.D.)

26583 INHIBITION OF TUMOR GROWTH BY CONFRONTATION WITH INCOMPATIBLE CELLS. POSSIBLE SURVEILLANCE MECHANISM AGAINST NEOPLASIA. **Moeller, Erna; Moeller, Goeran (Karolinska Inst., Stockholm. Serafimerlasarettet, Stockholm). Cancer, 20: 871-9(May 1967).**

Mouse sarcoma cells were mixed in vitro in the presence of phytohemagglutinin with irradiated lymphoid (3000 R) or neoplastic (15,000 R) cells of syngeneic and allogeneic origin, respectively, and thereafter inoculated into irradiated (350 R) mice of the strain syngeneic to the living tumor cells. Tumor cells brought into contact with allogeneic irradiated lymphoid cells were inhibited in their growth. This was not caused by immune reactions since F_1 hybrid lymphoid cells, incompetent to react against parental tumors, efficiently suppressed growth of parental tumor cells. Not only allogeneic lymphoid but also irradiated neoplastic cells could mediate tumor growth suppression. Inhibition of tumor growth was found after confrontation with cells being incompatible with regard to the H-2 system, various multiple non-H-2 systems and tumor-specific antigens in methylcholanthrene sarcomas. The authors conclude that confrontation of tumor cells with incompatible cells leads to growth suppression by nonimmunological mechanisms (allogeneic inhibition). This phenomenon may serve as one component of cell-mediated immune reactions and may act as a cell-to-cell surveillance mechanism against neoplasia. (auth)

26584 MELANOCYTIC AND NEVOCYTIC MALIGNANT MELANOMAS. CELLULAR AND SUBCELLULAR DIFFERENTIATION. **Mishima, Yutaka (Wayne State Univ., Detroit. Veterans Administration Hospital, Dearborn, Mich.). Cancer, 20: 632-49(May 1967).**

Two biologically and clinically different malignant melanomas are found in man. As compared to the malignant melanoma developed from junction nevus, the melanoma developed from Dubreuilh's precancerous melanosis has a slower rate of growth, metastasis and invasiveness. Furthermore, in contrast to melanoma of junction nevus origin, melanoma from Dubreuilh's melanosis is radiosensitive and does not assume the amelanotic form. Not only the malignant melanomas but also the premalignant stages exhibit differences. Dubreuilh's precancerous melanosis, in contrast to junction nevus, is a condition which occurs during later life in exposed areas, is radiosensitive and has a high incidence of malignant transformation. Cellular and subcellular differential characteristics expressing enzymic and ontogenic differences of these two melanomas are described. The author proposes that in the future we consider human malignant melanoma to be not one but two diseases — melanocytic malignant melanoma and nevocytic malignant melanoma. These may be called malignant melanocytoma and malignant nevocytoma, respectively. (auth)

26585 CHANGES OF THE SUM OF THE ACTION POTENTIAL ON A BUNDLE OF NERVE FIBERS BY X RAYS. **Vanselow, K. (Univ., Kiel). Atomkernenergie, 12: 219-22(May-June 1967). (In German).**

Radioinduced changes in the threshold of the action potential of nerve fibers were studied in x-irradiated frogs. Dependence of the effect on irritation frequency was investigated, and mechanical changes in the nerve membrane were calculated. (H.G.D.)

26586 MORTALITY AND CAUSES OF DEATH IN X-RAY TECHNICIANS. **Kitabatake, Takashi (Aichi Cancer Center Hospital, Nagoya, Japan); Komiyama, Kihachiro. Ind. Med. Surg., 36: 139-44(Feb. 1967).**

A small-scale survey is presented on the shortening of life span in persons occupationally exposed to ionizing radiations over a long period of time. Deceased x-ray technicians in Aichi, Gifu, and Aomori prefectures in Japan were surveyed. In 1962 and 1963, data on 52 x-ray technicians who died from 1933 to 1963 were collected. The control death rate used was that for Japanese male professional technical workers over 20 years of age in 1955. In each year, the x-ray workers' death rate was higher than that of controls. The actual number of deaths was larger than the expected number in all age groups. From statistical considerations, the mortality of x-ray technicians was inferred to be significantly higher than that of Japanese male technical (nonradiological) workers. Comparison of death causes in x-ray technicians and in controls was also made. The distribution of causes of death in x-ray technicians was considered to be nearly the same as that in controls. Among the causes of death, leukemia (1 case) and skin cancer (2 cases) might have been related to exposure to ionizing radiations. However, statistically the incidence of leukemia was not increased in x-ray technicians, although skin cancer appeared to be of significantly higher incidence. Life expectancy in x-ray technicians appeared to decrease more rapidly with increase in age as compared with controls, and their life expectancy was shorter by about 5 yr through all age classes than that of Japanese males with professional technical workers (nonradiological) in 1951 to 1952. This corresponded to a shortening rate of life expectancy at 20 yr of age calculated to be 0.68 days per 1 R. (BBB)

26587 EFFECT OF THYMECTOMY AND SPLENECTOMY ON THE COURSE OF X-RAY-INDUCED PROGRESSIVE INTERCAPILLARY GLOMERULOSCLEROSIS IN THE MOUSE KIDNEY. **Guttman, P. H. (Univ. of California, San Francisco). Intern. Arch. Allergy Appl. Immunol., 31: 163-73(1967).**

Whole-body neonatal irradiation (450 rad) of Swiss-Webster mice resulted in progressive intercapillary glomerulosclerosis (IGS). Neonatal thymectomy potentiated the effect of irradiation. Removal of the spleen at 18 days markedly reduced the effect of irradiation on the kidney when combined with thymectomy at birth. In the presence of an intact thymus, splenectomy had no effect on the course of radiation-induced IGS. Germinal center formation and plasma cell infiltration were observed in the thymus of splenectomized-irradiated mice. The possible role of immunity in the pathogenesis of late effects of x irradiation on the kidney is considered in the light of these findings. The possibility that autoimmunity is a factor in the pathogenesis of the late effects of irradiation on the kidney was suggested by the following observations: (1) A latent period precedes the onset of recognizable renal lesions after a single whole body exposure (375 to 500 rad); (2) The course of IGS is a progressive one subsequent to a single exposure; (3) Deposits of γG and β_{1C}-globulin are present at the site of the lesions. These deposits are quantitatively related to the severity of the lesion and similar in appearance to the deposits seen in the progressive IGS of normal aging mice; (4) In ultrastructural studies, electron dense deposits are demonstrable in the basement membranes and matrix of the mesangium. These deposits are similar to those seen in the basement membranes in experimental immune disease of the kidneys. (BBB)

26588 THE ACTION OF ^{60}Co GAMMA RAYS ON THE LIFE TIME AND FINE STRUCTURE OF PERIPHERAL THROMBOCYTES. **Sebestik, V. (Inst. for Hematology and Blood Transfusion, Prague); Pfisterer, H.; Huhn, D.; Stich, W. Blut, 14: 261-67(Feb. 1967).**

A possible complication of the increasing use of extracorporal irradiation of blood, for treatment of leukemia and amelioration of tissue transplantation reactions, is the injury to other formed elements in blood, particularly platelets. Thus, injury of platelets might result in thrombocytopenia and ensuing disorders of blood coagulation. To assess effects of such irradiation on platelets, rabbit platelets were irradiated in vitro (50,000-R doses of ^{60}Co γ radiation at 420 R/min) and reinjected in rabbits for life-time determinations or examined by electron microscopy. For survival studies platelets were labeled with ^{51}Cr. The results demonstrated the high radioresistance of platelets. Thus the mean life-time values of irradiated and nonirradiated platelets were 4.59 and 4.49 days. Moreover, electron microscopy failed to reveal any structural changes in the irradiated platelets. (BBB)

26589 CELLULAR RADIOSENSITIVITY AND TUMOR CURABILITY. **Powers, W. E.; Palmer, Lily A.; Tolmach, L. J. (Washington Univ., St. Louis). Nat. Cancer Inst. Monogr., No. 24, 169-86(1967).**

Tumor growth characteristics and cellular radiation sensitivity were studied using the Gardner lymphosarcoma, 6C3HED, induced in C3H mice by methylcholanthrene. An effort was made to detect a correlation between cell radiation sensitivity and tumor curability in animals, hoping that tumor radiosensitivity could be correlated with a high cellular sensitivity, and conversely, tumor radioresistance with a correspondingly lower cellular sensitivity. Large variations in cellular sensitivity have not been noted in tumor systems studied so far, so that the clinical variability of tumors in this respect is at present puzzling. The experimental tumor could be classified clinically as radiosensitive in that it disappeared after treatment with a relatively small dose of radiation; a single dose of 1500 rad caused complete regression. Furthermore, a large percentage of animals was cured with a dose of only 2000 rad. The main component of the tumor cell population, amounting to about 99% of the cells, exhibited a mean lethal dose (D_0) of about 110 rad, while for the remaining 1%, D_0 = 260 rad. This minor subpopulation behaved as if it were anoxic. This subpopulation was absent when cells were irradiated in suspension and consequently well oxygenated; it was decreased 10-fold when the tumors were irradiated in situ with the animals subjected to oxygen at 3 atm. Conversely, it was increased when the tumor cells were rendered anoxic by killing the animals before irradiation. In addition, the resistance of this subpopulation was not an inherited characteristic. The findings demonstrated that this experimental tumor system has several properties which complicate the simple model initially assumed. By taking into account the presence of a small anoxic cell population, of an immunologic rejection phenomenon, and of systemically distributed tumor cells, the observations could be reconciled with the model, but the model then becomes much more complex than was the original one. The question of the number of cells needed to reinitiate tumor growth after treatment is discussed. Many cells may be required, or a large number of cells may be left viable after irradiation to be inactivated by immune processes. The reasonably close correspondence, at lower doses, between calculated and observed cure rates in immunologically incompetent animals suggests that the latter is the more realistic picture. (BBB)

26590 SOME MATHEMATICAL AND STATISTICAL METHODS IN RADIATION THERAPY. **Woodbury, Max A. (Duke Univ. Medical Center, Durham, N. C.). Nat. Cancer Inst. Monogr., No. 24, 75-82(1967).**

A stochastic model of normal and tumor cell growth, recovery, and dissolution under exposure to high-energy radiation is outlined that is no more complex than the model of H. Porter (Brit. J. Radiol., 38: 607-12, 1964), but which removes a number of restrictive assumptions of his model. In the proposed model it is considered that critical sites or targets in the cells are involved in the mechanisms of the cell which repair radiation damage and that the cell is sterilized when all critical sites are hit before they can be repaired. It is assumed that each intact repair site causes a repair of damaged sites including other damaged repair units. Thus, if no repair sites remain undamaged the cell can no longer repair itself. Cells in which all repair sites are damaged are removed at a rate that will not affect the rest of the analysis. This feature is useful in the modeling of total tumor size. It is also assumed undamaged cells reproduce at a rate which depends on whether the cells are normal or cancerous but which affects the remainder of the analysis very little. The damage is assumed to be produced by random events in space and time (a Poisson process). When the resultant equations were explored mathematically, the direct analytic solution was found to be inordinately complex, so that a computer method for the solution of the equations was suggested (the method is not based upon finite difference approximations to the differential equations). It is pointed out that the model implies a threshold effect since low-level continuing radiation dosages (below threshold) will inactivate many cells but will sterilize few, whereas dosage above the threshold will rapidly kill cells. This has implications for treatment not present in previous models. (BBB)

26591 THE NORMAL SENSITIVITY OF HUMAN SKIN TO 250 AND 300 mμ ULTRAVIOLET IRRADIATION AND ITS DEPENDENCE ON THE THICKNESS OF THE STR. CORNEUM. Rottier, P. B. (State Univ., Utrecht). pp. 331-2 of Progress in Photobiology. Christensen, B. Chr.; Buchmann, B. (eds.). Amsterdam, Elsevier, 1961.

An approximate minimum erythema dose (MED) for the wavelengths regions of 300 and 250 mμ, to which the skin is particularly sensitive, was determined on the upper arms of 149 patients who did not suffer from light dermatoses. The mean sensitivity of the patients was highest during July–August and lowest during September–November (perhaps also during April–May). The lowest sensitivity occurred in periods when most light dermatosis cases were seen in the clinic. Moreover, an increase in the MED-300 was accompanied by an increase in the MED-250 and also by an increase in the ratio MED-250/MED-300. This ratio tended to be high when the mean sensitivity was low. This dependence of the ratio 250/300 on sensitivity indicated that the screening power of the horny layer which determines the overall sensitivity of the skin is greater for 250 mμ than for 300 mμ. Calculation of the dependence of the 2 MED's and their ratio was carried out. The values obtained made it possible to separate distinctly the abnormal MED's from those which were apparently determined with a low accuracy. In this way the normal MED-300 on the upper arm was established to be 24 mw sec/cm^2 for women (ratio 0.7) and 19 mw sec/cm^2 for men (ratio 0.6). The normal thickness of the horny layer on the upper arm varied over the range 8 to 27 μ. An increase of this thickness from 20 to 40 μ decreased the sensitivity for 300 mμ to about 1/8 of the normal sensitivity. This increase is easily obtained in normal persons by irradiation with uv light. (BBB)

26592 SYNERGISTIC ACTION OF RADIATION AND OF BACILLUS THURINGIENSIS TOXIN ON PROTOZOAN DISEASES OF INSECTS. Jafri, Rafat Husain (Panjab Univ., Lahore). pp 510-15 of Progress on Protozoological, Proceedings of First International Conference on Protozoology, Prague, Aug. 22–31, 1961.

Experiments are reported on the synergistic action of x rays and of Bacillus thuringiensis toxin on flour beetles, Tribolium castaneum and T. confusum, that were infected with the coccidian Adelina tribolii, the macrosporidian Nosema whitei (in T. confusum), or the schizogregarine Farinocystis tribolii (in T. castaneum). The beetles were exposed to x-ray doses ranging from 100 to 90,000 R. The mortality rate in noninfected, infected, and doubly infected beetles was evaluated. Mortality of Farinocystis-infected beetles after x-ray treatment was most markedly increased after low doses of x radiation. In comparison to the mortality of infected, nonirradiated beetles, the 100-R dose increased mortality 3 to 4 fold in T. castaneum during the first 40 days after treatment. The increase in mortality of beetles irradiated by higher doses (60,000 and 90,000 R) was less marked. The reaction of infected beetles to the 100-R dose during the first 15 days was the same as that of noninfected beetles exposed to 90,000 R. Similar synergistic effects were recorded for Adelina tribolii-infected T. confusum beetles. Mortality of noninfected beetles exposed to 60,000 and 90,000 R was lower than that of the infected ones. In general, diseased adults of both flour beetles were highly susceptible to x rays. Only a low toxicity of the B. thuringiensis toxin for the flour beetles was seen. Adelina-infected adults were killed in half the time required for the death of the noninfected beetles when a concentration of 25 × 10^7 spores of B. thuringiensis was used in the feeding flour. In larvae, the effect of bacteria or the combination of bacteria and Adelina infection was much slower but still significant. (BBB)

26593 X-RAY EXPERIENCE DURING PREGNANCY. Brown, Morton L.; Roney, Paul L.; Gitlin, Joseph N.; Moore, Raymond T. (Dept. of Health, Education, and Welfare, Rockville, Md.). J. Amer. Med. Ass., 199: 309-14(Jan. 30, 1967).

The extent of exposure to diagnostic irradiation in pregnancy was estimated in a sample representing 4100 live births in 1963. Since the use of x-ray equipment in the healing arts contributes an important segment of the total exposure of the U. S. population to radiation, a concerted effort is being made to ascertain the magnitude and distribution of relevant factors. Few studies of x-ray exposure in pregnancy have been reported, and there is very little available information to provide a basis for national estimates of exposure in utero. This represents a major gap in knowledge of lifetime exposure, particularly when considering somatic and genetic doses and their relation to radiation protection standards. On the basis of this national survey, the estimated medical x-ray visit rate during pregnancy was 26 per 100 women. The x-ray experience of pregnant women is significantly less than that of all women between the ages of 15 and 44 in the general population. Of the medical x-ray examinations during pregnancy, 21% occurred during the first trimester, 25% during the second trimester, and 54% during the third trimester. Practically all abdominal examinations related to pregnancy were done during the third trimester, whereas chest and other medical x-ray examinations were more evenly distributed over the three trimesters. Medical x-ray examination rates were highest for primiparous women and for those having high order births. (BBB)

26594 ACTION OF NATURAL IONIZING RADIATIONS ON THE REPRODUCTION OF METAZOANS: STUDIES ON DROSOPHILA MELANOGASTER. Planel, Hubert; Soleilhavoup, Jean-Pierre; Giess, Marie-Claude; Tixador, Rene (Faculte de Medecine, Toulouse). Compt. Rend., Ser. D, 264: 755-8(Jan. 30, 1967). (In French).

The protection of Drosophila melanogaster from natural ionizing radiation caused an inhibition or delay in development and the protected adult population of the first generation was always numerically less than that of control cultures. Results suggested that the concept of biological activity of natural ionizing radiations, already shown in the protozoans, was equally applicable to more complex multicellular organisms. (tr-auth)

26595 HODGKIN'S DISEASE DURING PREGNANCY. Lacher, M. J.; Geller, William. J. Amer. Med. Ass., 195: 486-8(Feb. 7, 1966).

Possible hazards of radiotherapy and chemotherapy in pregnant women are considered in relation to treatment of Hodgkin's disease. X-ray therapy of distant areas with adequate shielding of the uterus is considered by some radiotherapists to be the preferred palliative treatment for malignancy outside the abdomen and pelvis. But this entails risk and is not considered a completely safe substitute for chemotherapy, which itself may be hazardous to the fetus. Diagnostic x-ray procedures alone may provide a sufficient amount of radiation to significantly increase the cancer mortality of offspring of mothers exposed at any time during pregnancy. The dose-response relation for childhood cancer appears to show no threshold and to be linear down to below the dose received by the embryo in a single pelvic x-ray picture. Some data indicate a 1% increase in mortality for each 17 mR to the embryo in the diagnostic range. Considering a mean value of 300 mR per diagnostic exposure and the dose the fetus might receive from therapeutic radiation during pregnancy (a range of 2 to 27 rad even with the abdomen well shielded) the danger of diagnostic radiation and especially therapeutic radiation becomes evident. Diagnostic x-ray studies, x-ray therapy, and chemotherapy should be avoided in all pregnant patients whenever possible because potential damage to the fetus is increased by these methods (although the manifestations of this may not be apparent until later in childhood). (BBB)

26596 FLUORESCENCE OF BONE. Bachman, Charles H. (Syracuse Univ., N. Y.); Ellis, Eric H. Nature, 206: 1328-31 (June 26, 1965).

Induction of fluorescence in bone by soft x rays and uv radiation was studied. No fluorescence was seen in bone under irradiation by x rays, at least for energies from about 100 KV down to about 20 KV. Very weak fluorescence was observed under cathode-ray bombardment. With uv irradiation, measurable fluorescence began to appear above about 3000 Å and accordingly a 3650 Å mercury source was used to study the phenomenon farther. Light from the Hg lamp irradiated the bone after passing through filters which restricted the range to about 3400 to 3900 Å. Bone samples observed from clinically normal human tibiae and femora, and dog femora all gave spectral curves showing a common pattern, consisting of a major peak at 4400 Å and 2 minor peaks at 5900 Å and 6400 Å. Both decollagenation and demineralization processes caused a reduction in fluorescent efficiency of the remaining component compared with the original whole bone. A more rapid reduction occurred with decollagenation, the efficiency dropping to 50% in 12 hr. Demineralization caused the same percentage of reduction in 3 days. Collagen generally fluoresced more strongly than apatite and was less affected by the separation process. Evidently the combination, collagen with included apatite, was the prime source of fluorescence. The weak fluorescence of collagen-free geological samples and chemical samples suggested that the role of the collagen in the matrix may be to enhance the fluorescence of the internally bound apatite crystals. (BBB)

26597 "PULSELESS DISEASE" COMPLICATING HODGKIN'S DISEASE: A CASE APPARENTLY CAUSED BY RADIOTHERAPY. Heidenberg, William J.; Lupovitch, Aaron; Tarr, Norman (Public Health Service Hospital, Baltimore). J. Amer. Med. Assoc., 195: 488-91(Feb. 7, 1966).

Radiation injury which was seen clinically as pulseless disease is described as occurring in a 21-yr-old woman with Hodgkin's disease. Because of enlarged lymph nodes she had initially received a total dose of 2500 rad of 250-KV x rays over an 18-day period directed to the supraclavicular areas. This was followed 2 yr later by a series of doses totaling 1650 rad and 3 yr later by another 2100 rad to the same region. Numbness of both arms and coolness of the hands were experienced several years later. No pulse or blood pressure could be obtained in either upper extremity. At autopsy, the lumens of the subclavian arteries were seen to be obliterated by dense subintimal and intraluminal fibrosis. The musculature of the vessel walls was hyalinized and the elastica was frayed and thickened. Similar changes were noted in the proximal portions of the innominate and left common carotid arteries. The cause for this case of pulseless disease was thought to be radiation damage to previously normal arteries. Fibroblastic proliferation in the intima and media and fraying or loss of the elastica are characteristic radiation effects on arteries. Large vessel damage may occur with doses above 500 R, and actual perforation of the aorta has been reported following irradiation therapy for carcinoma of the esophagus. The radiation effect may be progressive, with fibroplasia occurring as late as 4 yr after the last exposure. Extensive radiation was directed to the areas traversed by brachiocephalic vessels in the case described. (BBB)

26598 RESULTS OF RADIOIODINE THERAPY IN THYROTOXICOSIS. Donovan, J. K.; Turtle, J. R. Med. J. Aust., 2: 271-2(Aug. 6, 1966).

Incidence of hypothyroidism as a complication of ^{131}I treatment of hyperthyroidism and means of reducing it are considered. In 170 patients treated with radioiodine over an 11-yr period the incidence of hypothyroidism was 13%, reaching a plateau 2 yr after the last dose of ^{131}I, with only one case appearing later than 2 yr. There was no occurrence of thyroid carcinoma, hypoparathyroidism, or precipitation of thyroid crisis in this series. The induction of thyroid carcinoma has not been shown to occur in adults, but in children the appearance of papillary carcinoma of the thyroid has been reported after ^{131}I therapy. Thyroid storm and hypoparathyroidism are extremely rare. Genetic mutation as a result of ovarian irradiation is unlikely to occur because of the low dose (~0.45 rad/mCI of ^{131}I) and there is no evidence for leukemogenesis as a result of bone marrow irradiation. Examination of the literature shows that a high incidence of hypothyroidism occurs whether the dose employed is a result of precise quantitation or is calculated on an empirical basis. Formulae based on estimates of thyroid size after scanning procedures, together with the results of a 24-hr ^{131}I thyroidal uptake test after a tracer dose, are usually designed to deliver a dose of 7000 rad to the thyroid. Empirical doses are frequently lower than those calculated, and thus it might be expected that the incidence of hypothyroidism would be lower. It is possible that a lower incidence of hypothyroidism may occur with the use of empirical dosages of ^{131}I, which usually result in less irradiation to the thyroid. Although repeated doses of ^{131}I were required to control hyperthyroidism in 28% of the patients in this series, the incidence of hypothyroidism was significantly lower than in comparable studies. (BBB)

26599 HISTOPATHOLOGICAL ASPECTS OF THE MUCOSA OF THE SMALL INTESTINE OF THE IRRADIATED GUINEA PIG (HISTOLOGICAL, HISTOCHEMICAL, AND MICRORADIOGRAPHICAL STUDIES). Randaccio, M.; Arena, G. C. (Univ., Turin. Ospedale Maggiore, Vercelli, Italy). Minerva Radiol., Fisioterap. Radiobiol., 11: 594-600(Nov. 1966). (In Italian).

Adult guinea pigs were irradiated with 400 rads given in a single dose. Fragments of duodenum obtained at different times after irradiation were examined histologically, histochemically (selective stains for nucleic acid and mucopolysaccharides), and microradiographically. The observed results confirmed the data reported in the literature, i.e., essentially the high sensitivity of the intestinal cells, the regenerative capacity of the epithelium of the criptae, and the radioresistance of the pancreas. Other interesting data were also observed: essentially, the formation of a granulation tissue giving rise to periglandular fibrosis at the base of the villi and in the submucosal layer, with unreversible connectival organization. Microradiography proved an especially valuable method in revealing qualitative variations of the connective component. (auth)

26600 DELAYED RADIOBIOLOGICAL EFFECTS ON THE CENTRAL NERVOUS SYSTEM OF RABBITS. ELECTROENCEPHALOGRAPHIC AND HISTOLOGICAL ALTERATIONS. de Romanis, F.; Pompeo, I. (Univ. of Rome. Filippo Hospital, Rome). Minerva Radiol., Fisioterap. Radiobiol., 11: 578-93 (Nov. 1966). (In Italian).

The heads of 30 rabbits were irradiated. Below 5,000 R no signs of general damage nor EEG alterations were observed for the whole survival time. The animals were sacrificed after four months and presented no appreciable morphological alterations in the encephalic nervous tissue. In rabbits irradiated with 10,000, 15,000, and 20,000 R the survival time was related to the dose of radiation although in each group the latency of the onset of signs of general damage and the outcome varied. Four types of histological alterations were observed in the nervous tissue: necroses affecting the cortex and white matter corresponding with the irradiated region, which in some cases extended deep down; edema in the white matter and in the deep layers of the cerebral cortex almost always associated with serious necrotic lesions; inflammatory alterations characterized, in cases with extensive necroses, by lymphocytes, monocytes, and plasma cells in the leptomeninges corresponding to the altered regions; and vasal alterations, mainly represented by fibrinoid necroses of the small arteries in the leptomeninges and in the cerebral cortex and by the fibrous thickening of the small vessels in the cortex, particularly in evidence around the necrotic foci. The EEG alterations observed in the irradiated rabbits often consist of slow diffuse activities, sometimes prevalent to one side; also noted were unilateral lesions (slow frequencies and recording of sharp waves). Fairly limited hemispheric anatomical damage was evident in the latter cases. The present observations did not reveal any appreciable relation between irradiation dose and the extent, the type of histological alteration, and the characteristics of the EEG tracing. Noteworthy was the fact that the EEG alterations are observable in rabbits irradiated with 20,000 R in 10 times less time than in those irradiated with 10,000 R and 2 to 4 times less time than in those irradiated with 15,000 R. In all cases they precede the clinical picture of severe general damage which will cause the animal's death; however, the latency between EEG alteration and outcome is extremely variable and does not depend on the dose administered. (auth)

26601 BONE METASTASES, OSTEOPOROSIS, AND RADIATION NECROSIS IN BREAST CANCER. Ratzkowski, E.; Frankel, M.; Hochman, A. (Hadassah Univ., Jerusalem). Clin. Radiol., 18: 146-53(Apr. 1967).

Skeletal metastases are often the first sign of malignant spread in patients with breast cancer. Correct interpretation of bony changes may be difficult, since metastases, degenerative disorders and radiation damage may all occur in such cases and produce similar radiological changes. To illustrate these difficulties a series of 22 patients, previously treated for breast cancer and who subsequently developed bony lesions, is described. It is important to try and recognize the true nature of the bony changes, since treatment and prognosis will depend upon this. Adrenalectomy may be contemplated for patients who have no more than metabolic osteoporosis, and further irradiation will aggravate bony lesions due to radionecrosis. To avoid such errors attention must be given to the general condition of the patient, to the presence of co-existing metabolic disorders, to signs of progressive disease and to radiological changes in the skeleton as a whole. Thus, x rays of other bones may reveal the presence of lesions typical of metastases or diffuse osteoporosis. Skeletal changes limited to the irradiation fields over a period of time, perhaps associated with irradiation damage to the lungs or skin, will suggest radionecrosis. In a number of cases the correct diagnosis will have to remain in doubt for some time. (auth)

26602 RADIATION INJURY OF THE SKIN. Varnai, Gy.; Kovacs, L. Magyar Radiol., 19: 114-24(Apr. 1967). (In Hungarian).

Factors influencing the skin reactions are discussed. The macroscopic and microscopic appearance of the alterations and the reaction of the skin appendages are dealt with. The authors point out the importance of the ray dose with respect to the gravity of the skin changes. The radiation injuries being practically combined lesions necessitate complex therapy. (auth)

26603 ACUTE ULTRASTRUCTURAL EFFECTS OF 500 ROENTGENS ON THE LYMPH NODE OF THE MOUSE. Smith, Edward B.; White, David C.; Hartsock, Robert J.; Dixon, Arthur C. Amer. J. Pathol., 50: 159-65(Jan. 1967).

The ultrastructural alterations in lymph node lymphocytes and histiocytes in the mouse during the first 6 hr after 500 R whole-body irradiation are described. A half hr after irradiation, histiocytes exhibited prominent pseudopodia particularly enlarged when near damaged lymphocytes. Damaged lymphocytes showed aggregation of chromatin near the nuclear membranes, smudged and abnormally electron-dense mitochondria, and a tendency to widening of the perinuclear space with separation of the nucleus and cytoplasm. At 1 hr histiocyte pseudopodia became more prominent and changes in the lymphocytes included disarray of ribonucleoprotein particles. Three hr after irradiation chromatin in lymphocyte nuclei had condensed at the nuclear membrane and the center of the nucleus was electron-lucent. Focal sectors of separation between nucleus and cytoplasm occurred in the obviously damaged cells. Histiocyte pseudopodia lay in contact with damaged and apparently dying lymphocytes. In some instances, pyknotic nuclei or whole cells with pyknotic nuclei appeared within phagocytic vacuoles in histiocytes as early as 3 hr after irradiation. At 6 hr many dense, shrunken, and fragmented nuclei as well as membranous remnants of cytoplasmic organelles were noted within phagocytic vacuoles in histiocytes. Some of these remnants could be identified as mitochondria whereas other debris was unidentifiable. (auth)

26604 ENZYME CYTOCHEMISTRY OF ^{131}I IRRADIATED THYROID GLAND. Sobel, Harold J. (Beth Israel Hospital, Passaic, N. J. New York Medical Coll., Flower and Fifth Avenue Hospitals, New York, N. Y.). Amer. J. Pathol., 50: 39-57(Jan. 1967).

The effect of ^{131}I irradiation on rat thyroid gland was studied cytochemically by enzyme visualization techniques for plasma membranes, lysosomes, Golgi apparatus, mitochondria, endoplasmic reticulum and periacinar vascular channels. Alterations were observed in each of these organelles; those in the apical plasma membranes and lysosomes preceded any changes noted with conventional methods. These and the Golgi changes preceded the earliest vascular abnormality noted. Similar observations have been made in other forms of thyroid injury in the rat and the guinea pig and in other irradiated tissues, these alterations were considered nonspecific reactions to injury. One or more previously undescribed lysosomal acinar cell phosphatases were observed, and the probable adsorption of DPNH-Nitro-BT reductase by lipid was noted. (auth)

26605 MODIFICATION OF LEVEL OF BLOOD SUGAR IN TUMOR PATIENTS DURING EXPOSURE TO IONIZING RADIATIONS. Bompiani, C.; Falcetti, E.; Matronola, V.; Paleani-Vettori, P. G. (Univ., Rome). Nunt. Radiol., 32: 547-62(July 1966). (In Italian).

The behavior of glycemia in the first phases of the exposure to therapeutic doses of ^{60}Co γ radiation was studied in patients affected by tumors in different sites of the body. Changes in the blood sugar level observed during the course of irradiation attained their maximal value 30 to 60 min after its end, and were observed in all patients. The statistical analysis of the data reveals that the observed changes are really induced by the exposure to the radiations; that the variation in the blood sugar level is proportional to the variations of integral dose and not of depth of dose; that the irradiated area influences the changes in glycemia, and that the variation is maximal for the laterocervical region; and that the blood sugar level before irradiation does not influence the degree of the reaction after irradiation. (auth)

26606 THE EFFECT OF X-IRRADIATION ON THE LYSOSOMES OF MOUSE MAMMARY GLAND CARCINOMAS. Brandes, David; Sloan, Kenneth W.; Anton, Elsa; Bloedorn, Fernando (Johns Hopkins Univ., Baltimore. Baltimore City Hospitals. Univ. of Maryland, Baltimore). Cancer Res., 27: 731-46(Apr. 1967).

The distribution of acid phosphatase in mouse mammary tumors was studied by light and electron microscopy technique. Following x irradiation, the concentration and size of the lysosomes in the tumor cells were increased, and final reaction products of the histochemical test were detected free in the cytoplasm and in intercellular spaces. Areas of focal degradation and necrobiosis appeared associated with enlarged lysosomes, and were more frequently detected in the irradiated tumors from mice treated with vitamin A. Ionizing radiation appeared to provoke the release and activation of lysosomal hydrolases and these seemed to be associated with the degradative changes in the tumor cells. Lysosomes, characterized by their acid phosphatase activity, were detected in the irradiated tumor cells prior to the onset of easily detectable cytoplasmic changes by routine histologic preparations. The use of the acid phosphatase test may represent a convenient method for detecting early cytologic changes following irradiation. (auth)

26607 EFFECT OF LETHAL X-IRRADIATION ON URINARY CORTISOL AND 2α- AND 6β-HYDROXYCORTISOL EXCRETION PATTERNS AND PRODUCTION RATES IN GUINEA PIGS. Burstein, Shlomo; Pincus, Gregory (Worcester Foundation for Experimental Biology, Shrewsbury, Mass.). Endocrinology, 80: 947-52(May 1967).

The effect of fatal whole body x irradiation (1000 R) on the urinary excretion of corticosteroids was studied in 2 guinea pig strains distinguished by high and low urinary hydroxylated cortisol derivatives ("high" and "low" producers). Following x irradiation, there was a progressive drop in the urine output in the 2 strains. During radiation sickness, the high producers exhibited a significantly higher urinary excretion of polar corticosteroids such as 2α- and 6β-hydroxycortisol as compared to sham-irradiated animals. This resulted in an "inverted" excretion pattern with the polar corticosteroids becoming the dominant characteristic. The pattern changes were less apparent in the low producers because of their limited ability to form these compounds. Production rates of cortisol, 2α- and 6β-hydroxycortisol were determined in high producers from the cumulative specific activities of the urinary steroids following tracer injections. During the 24 hr which followed irradiation and 4 days thereafter when the animals showed signs of radiation sickness, there was a statically significant increase in the production rates of the 3 steroids studied which was 2-, 2- and 3-fold higher, respectively, over that found in sham-irradiated animals. The in vivo conversion of cortisol to 2α-hydroxycortisol and 6β-hydroxycortisol was not significantly affected by irradiation. (auth)

26608 MAINTENANCE AND FUNCTION OF CORPORA LUTEA IN RABBITS DEPEND ON ESTROGEN. Keyes, P. L.; Nalbandov, A. V. (Univ. of Illinois, Urbana). Endocrinology, 80: 938-46 (May 1967).

Pregnant rabbits with one x-irradiated ovary which contained normal-appearing Corpora lutea (CL) and interstitial tissue aborted after removal of the contralateral normal ovary containing all ovarian components. The suspicion that estrogen may be essential for CL maintenance and function was confirmed by the injection of estradiol (2-4 μg/day) into rabbits with only an x-irradiated ovary containing just CL and interstitial tissue. Pregnancy was maintained in these females and both the CL and the ovarian effluent blood contained chemically measurable quantities of progesterone. Withdrawal of estrogen caused cessation of progesterone synthesis and secretion and led to abortion. At doses used, neither purified NIH-LH nor crude anterior pituitary powder could, in the absence of estrogen, maintain either the morphology of Corpora lutea, or the synthesis of progesterone, or pregnancy. The conclusion is reached and documented that estrogen may act directly on the CL but whether its action is only luteotrophic, or both luteotrophic and steroidogenic, remains to be determined. (auth)

26609 IMMUNOELECTROPHORETIC STUDY OF THE BONE MARROW OF THE IRRADIATED RAT. Zaorska, B.; Deckers, C.; Dunjic, A. (Institut du Cancer, Louvain, Belg.). Rev. Franc. Etude. Clin. Biol., 7: 169-75(Feb. 1967). (In French).

Study of homogenates of x-irradiated or non irradiated bone marrow or marrow cell fractions obtained after centrifugation by a density gradient, the immunoelectrophoretic method allowed resolution of five lines of precipitation corresponding to non seric tissue antigens. After irradiation, some marrow cell antigens disappear. A correlation exists between the disappearance of these antigens and the administrated radiation dose. After sublethal irradiation, the observed modifications are only temporary. (auth)

26610 CELL SUSCEPTIBILITY TO TRANSFORMATION BY X IRRADIATION AND FIXATION OF THE TRANSFORMED STATE. Borek, Carmia; Sachs, Leo (Weizmann Inst. of Science, Rehovoth, Israel). Proc. Nat. Acad. Sci. U. S., 57: 1522-7(May 1967).

Hamster embryo cells were x-irradiated with 300 R in studies designed to determine: whether there is both a hereditary and a physiological state of cell competence to transformation induced by irradiation; the time required for expression of the transformed state; the time required for a loss of fixation of the transformed state in confluent cultures; and whether the loss of fixation in confluent cultures can be prevented by incubation at 24°C instead of at 37°C. Results indicated that only some cells in the mixed embryo cultures were susceptible to radioinduced transformation and that these cells were selected against by passaging. Irradiation of cells at any time from one to nine days after seeding for cloning gave a similar percent of transformed colonies. However, after the fourth day, the colonies were transformed either in sectors or only on the circumference. Loss of fixation in confluent cultures required incubation at 37°C for more than two days. Incubation at 24°C did not inhibit the loss of fixation of the transformed state in confluent cultures, but did not appear to increase the frequency of transformation. The loss of fixation of the transformed state in confluent cultures is attributed to a mechanism of error-correction that is inhibited by incubation at 24°C. (H.G.D.)

26611 RADIATION HAZARDS AND INJURIES DURING INTRAUTERINE LIFE. Unnerus, C.-E. Duodecium, 81: 530-5 (1965). (In Finnish).

26612 COMPARISON OF PHOSPHOLIPID BIOSYNTHESIS IN IRRADIATED BONE MARROW AND LIVER. Lim, James K. J.; Piantadosi, Claude; Snyder, Fred (Oak Ridge Associated Univ., Tenn. Univ. of North Carolina, Chapel Hill). Proc. Soc. Exp. Biol. Med., 124: 1158-61(Apr. 1967).

This paper describes the comparison of phospholipid pool sizes and the incorporation of labeled fatty acids into phospholipids of irradiated bone marrow and liver of rats. Total phospholipid phosphorus, lecithin P, and cephalin P of bone marrow, but not of liver, were markedly decreased in rats 4 days after whole-body irradiation. Experiments measuring the incorporation of palmitic-1-^{14}C and oleic-1-^{14}C acids into various phospholipids of blood serum, liver, and bone marrow of normal and irradiated rats revealed that the lecithin was the major phospholipid incorporating radioactivity in all tissues. Whole-body irradiation did not appear to exert any effect on the specific activities of these phospholipids in any of the tissues studied. Although radioactivity distribution studies showed little change in liver and serum, radiation significantly decreased the amounts of both palmitic-1-^{14}C and oleic-1-^{14}C acids incorporated into bone marrow phospholipids. (S.M.H.)

26613 RADIATION SENSITIVITY OF THE HIBERNATING GROUND SQUIRREL, CITELLUS TRIDECEMLINEATUS. Barr, R. E.; Musacchia, X. J. (Univ. of Missouri, Columbia). Proc. Soc. Exp. Biol. Med., 124: 1204-7(Apr. 1967).

This paper describes the effects of various high levels of ^{60}Co gamma on hibernating and non-hibernating ground squirrels and the radioprotective characteristic of the hibernating mammals. Seventy-two animals were taken from a colony of stock animals. From the same stock 12 animals were used as controls. The experimental animals were given 1000r to 3000r whole-body irradiation at a dose rate of 200 R per min. Following irradiation of the hibernating squirrel, rectal temperature and respiration rate were recorded. Each animal was then aroused. Following irradiation all animals in both groups and controls were placed in plastic cages for observation. The basic conclusion of this report is that irradiated hibernating ground squirrels do not respond as active animals following arousal as has been reported, rather, there is a protective effect relatable to hibernation. The hibernators have a longer "mean survival time" and an increased LD$_{50}$. (S.M.H.)

26614 RESPONSE OF GUINEA PIG TO SUBLETHAL X-IRRADIATION AND LIVE TULAREMIA VACCINE. Nutter, John E.; Eigelsbach, Henry T. (Biological Sciences Lab., Frederick, Md.). Proc. Soc. Exp. Biol. Med., 124: 1227-30(Apr. 1967).

Sublethal whole-body x irradiation of the guinea pig before or after respiratory vaccination with normal innocuous *Pasteurella tularensis* LVS may result in death. No evidence of a change from a self-limiting to a fulminating type of infection was obtained. Irradiated vaccinated animals produced agglutinin titers only slightly lower than nonirradiated controls. Only a small decrease in resistance to tularemia was observed between surviving irradiated vaccinees and nonirradiated vaccinees. (auth)

26615 RADIATION DEATH FROM CARDIOVASCULAR SHOCK FOLLOWING A CRITICALITY ACCIDENT. REPORT OF A SECOND DEATH FROM A NEWLY DEFINED HUMAN RADIATION DEATH SYNDROME. **Fanger, Herbert (Rhode Island Hospital, Providence); Lushbaugh, Clarence C. Arch. Pathol., 83: 446-60(May 1967).**

Two case histories of nuclear radiation victims are similar and reflect radiation-induced hypotension, vascular damage, shock, and death within two days. Pathologic changes in one patient are described that show these two cases to represent a lethal subsyndrome of the acute radiation syndrome, occurring in the dosage range between the acute gastrointestinal and neurologic subsyndromes. Because meningeal and cortical changes occur as part of the vascular damage, terminal neurologic symptoms occur that lead to the suspicion of neurologic damage. Only minimal neuronal damage and glial reaction were present, however, and death apparently resulted from increased intracranial pressure, cerebral anoxia, cardiac failure, and massive peripheral edema. (auth)

26616 SPECIFICITY OF THE RELATIONSHIP BETWEEN THYMIC ALKALINE PHOSPHATASE ACTIVITY AND LYMPHOMA DEVELOPMENT IN STRAIN C57BL MICE. **Lagerloef, Bengt A. M.; Kaplan, Henry S. (Stanford Univ. School of Medicine, Palo Alto, Calif.). J. Nat. Cancer Inst., 38: 437-58(Apr. 1967).**

Experiments were undertaken to confirm and elucidate the significance of the observation, previously reported by other investigators, that alkaline phosphatase (AP) activity, normally not demonstrable in the thymic lymphoid cells of adult C57BL mice, appears during the development of radiation-induced thymic lymphomas. Histochemical studies revealed faint AP in the thymus of 17-day embryos but none in the thymic lymphoid cells of newborn C57BL mice or in those of older mice up to 180 days of age. Thymic AP did not appear in response to adrenalectomy or the administration of corticosteroids in thymolytic doses, though the latter treatment sharply increased splenic AP activity. Splenic AP activity was also increased in neonatally thymectomized animals that developed the wasting syndrome and in others with spontaneous runting. Histochemical and histopathological studies were performed on consecutive serial sections of samples from the thymuses of C57BL mice killed at various intervals after: exposure to whole-body x irradiation; thigh-shielded irradiation; intrathymic injection of a passage line of a leukemogenic virus (RLV) originally extracted from a radiation-induced lymphoma; and saline injection. Preliminary studies on the variation of AP activity during serial transplantation of virus-induced lymphomas are also reported. The data support the view that the development of AP activity in murine thymic lymphomas is a specific response induced concomitantly with and directly related to the neoplastic transformation per se, and not merely a reflection of cellular immaturity or a nonspecific response to trophic or involutional stimuli. (auth)

26617 REDUCED SECONDARY DISEASE MORTALITY IN MOUSE RADIATION CHIMERAS. **Congdon, C. C.; Gardiner, D. A.; Kastenbaum, M. A. (Oak Ridge National Lab., Tenn.). J. Nat. Cancer Inst., 38: 541-8(Apr. 1967). (ORNL-P-2319).**

A program was undertaken to ascertain the role of donor marrow age, cell dose, day of injection after irradiation, and sex as single or interacting factors in determining the 90-day cumulative mortality from secondary disease in mouse radiation chimeras. It was found that 40 million 3-day-old donor marrow cells gave the fewest deaths (~5%). An experimental design approach was used, and the present report concerns a 2×3^3 factorial design. Extrabinomial variation in deaths among mice in different cages was absent from Design 4, and no animals in the experiments reported here died earlier than 12 days after 950 R x irradiation. (auth)

26618 INDUCTION OF TUMORS IN ADULT HAMSTERS WITH SIMIAN VIRUS 40. **Allison, A. C.; Chesterman, F. C.; Baron, S. (National Inst. for Medical Research, London. Imperial Cancer Research Fund, London. National Inst. of Allergy and Infectious Diseases, Bethesda, Md.). J. Nat. Cancer Inst., 38: 567-72(Apr. 1967).**

Certain effects of age and route of inoculation on simian virus 40 (SV40) tumor formation in Syrian hamsters have been examined. Approximately 20% of hamsters 4 months of age inoculated subcutaneously with virus developed tumors at the sites of inoculation after very long latent periods. Some tumors were transplantable and contained SV40 complement-fixing and transplantation antigens. In 4-month-old hamsters inoculated with virus directly into the cheek pouch, and in irradiated animals of this age inoculated subcutaneously, tumors appeared much sooner and in somewhat higher frequency than in intact animals inoculated subcutaneously. It is concluded that the resistance of adult animals to virus oncogenesis is relative, not absolute, and that potentially malignant cells can remain dormant for the greater part of the lifespan of the animals. Procedures that diminish the effectiveness of the host's immune response favor emergence of tumor cells. (auth)

26619 STUDY OF CHROMOSOME DAMAGE IN HUMAN LYMPHOCYTES INDUCED BY SERIAL DOSES OF IONIZING RADIATIONS APPLIED TO THE LUMBOSACRAL PORTION OF THE SPINE. **Riggio, G.; Cardini, G.; Galimberti, A. (Ospedale Riuniti, Verbania, Italy). Arch. Ortop., 78: 293-9(1965). (In Italian).**

Lymphocyte cultures were made in patients receiving 50-R daily doses of radiation to the lower spine for spondylitis. Cultures were made after accumulated doses of 50, 250, and 500 R. Control cultures taken before irradiation showed only the normal rate (0.4%) of tetraploid cells. In 5.2% of the mitotic figures examined the chromosome number was less than normal. Cultures taken 24 hr after 50-R irradiation showed only 89.5% normal mitoses, and the percentage of tetraploid cells was increased to 1.9%. About 8% of the mitoses were abnormal. After 250-R cumulative doses the percentage of abnormal cells was 16%, and tetraploid cells amounted to 5.6%. After 500 R abnormal mitoses reached 24% and tetraploidy 6.5%. The percentages of abnormal chromosomes after 50-, 250-, and 500-R doses were 0.3, 0.5, and 0.8%. Incidence of fragmented and dicentric chromosomes were progressively increased as cumulative dose increased. (BBB)

26620 SELECTIVE MITOCHONDRIAL DAMAGE BY A RUBY LASER MICROBEAM: AN ELECTRON MICROSCOPIC STUDY. **Amy, Robert L.; Storb, R. (Centre National de Transfusion Sanguine, Paris). Science, 150: 756-8(Nov. 5, 1965).**

A ruby laser mounted on a phase-contrast microscope was used for irradiation of KB tissue-culture cells growing in a monolayer. Mitochondria were selectively damaged in single cells by a focused microbeam. The cells had been vitally stained prior to irradiation with Janus green B because of its mitochondrial specificity. Presumably the strain enhanced the organelle's ability to absorb laser light since unstained cells showed no detectable reaction to such radiation. Morphological evidence for the fact that the induced damage is restricted to the mitochondria was based on electron micrographs of irradiated cells. Other cellular constituents in the exposed area showed no significant ultrastructural alteration. Gross cellular changes produced by the microbeam were visible with phase-contrast optics as small, dark masses whose sizes varied directly with the incident energy. Under the electron microscope, such masses were clearly recognizable as small clumps of mitochondria each of which was altered strikingly. The remains of an individual mitochondrion consisted of the inner and outer membranes surrounding electron-opaque areas that were presumed to be carbonized portions of the organelle: only fragments of cristae were visible. The damage appeared to be the result of thermal and mechanical forces produced as a consequence of energy absorption by the stained organelles. Long-term experiments with KB cells irradiated in Rose chambers showed that most of them survive and are able to divide, an indication that other cellular constituents are not deleteriously affected by laser light. Evidence based on enzyme and autoradiographic studies provided additional support for this conclusion. (BBB)

26621 LASER COAGULATION OF THE ANTERIOR SEGMENT. I. EXPERIMENTAL LASER IRIDOTOMY. Snyder, William B. (Univ. of Texas, Dallas). Arch. Ophthalmol. (Chicago), 77: 93-8 (Jan. 1967).

The histology and appearance of acute and chronic iris lesions produced by laser radiation are reported. The method and results of repeated laser irradiation on local iris atrophy and peripheral iridotomy formation are also described. The irises of 10 pigmented Dutch rabbits were exposed to the pulses ruby laser beam (0.3 J). Single firings produced atrophic hyperpigmented lesions. The hyperpigmentation was due to pigment-filled macrophages. In another group of young pigmented Dutch rabbits, laser irradiations were given to each eye in two peripheral iris sites. This was repeated three more times at weekly intervals. In 42 of 44 sites peripheral colobomas developed. Lens damage was not seen over a 9-month observation period. During the stage of partial focal iris atrophy, laser light filtered through the iris, and the retina was accidentally coagulated. In a third group, a lower energy level (0.15 J) did not harm the retina, but the incidence of iridotomies fell to 20%. Though this technique with higher energy beams yielded a high percentage of peripheral iridotomy lesions, the retinal damage precludes its use as a method for refashioning pupils or as a substitute for peripheral iridectomy. (BBB)

26622 THYROID CARCINOMA AND X IRRADIATION: THERAPEUTIC RADIATION VERSUS DIAGNOSTIC ROENTGENOLOGY. **Silverman, Frederic N. Pediatrics, 38: 943-5 (Dec. 1966).**

Up to the present, nearly 300 cases were documented in which thyroid carcinoma was preceded over a variable period of years by therapeutic irradiation to the head, neck, and chest. Between 1955 and 1962, epidemiologic studies of children exposed to therapeutic irradiation provided further support to the hypothesis that thyroid carcinoma and prior x irradiation were causally related. As a consequence of these reports, concern over excessive radiation has replaced concern over an enlarged thymus, and the practice has fallen into disrepute. The radiation administered to the children who developed thyroid cancer was in the therapeutic range and not the diagnostic range. The doses, where they could be ascertained, ranged from 250 to 1500 R. Several publications indicate a threshold level of about 180 R in infants and children. The mechanism of induction of neoplasia following radiation is not clear. The increased susceptibility of children's thyroids to cancer induction by irradiation was well documented. Carcinoma was found after doses as little as 100 R whereas, in the adult, the lowest dose is in the order of 2000 R. There are only two, and possibly three, children in whom thyroid carcinoma has been found following therapeutic doses of ^{131}I for hyperthyroidism, and in such instances the doses were estimated at 10,000 to 20,000 RAD. The discrepancy in carcinogenic dose between the two modes of administration of ionizing radiation may be due to factors of distribution as well as dose rate. In the children receiving x irradiation, the dose rates were of the order of 5 to 100 R/min. With ^{131}I, the dose rates are about 1 to 2 R/min. (BBB)

26623 THYROID CARCINOMA AND X IRRADIATION: THERAPEUTIC RADIATION VERSUS DIAGNOSTIC ROENTGENOLOGY. Silverman, Frederic N. Pediatrics, 38: 943-5 (Dec. 1966).

Various data indicate a relatively low radiosensitivity of the myocardium on the basis of animal experiments and reactions to radiotherapy in humans. Studies were conducted in 15 patients undergoing thoracic irradiation (220-kv x rays) to measure changes in myocardial metabolism by the Glucotest. Six of the patients had primary lung tumors, 4 had mammary cancer, and 4 had disseminated mediastinal cancer. Glucotest was conducted before, three, and six months after irradiation. In patients with mammary cancer the Glucotest was negative, indicating an absence of postirradiation myocardial lesions, after absorbed doses up to 1500 R were received. In five patients with lung cancer myocardial injury was present after the heart had adsorbed doses of 5000 to 6000 R. The results show that heart muscle tissue is susceptible to injury during thoracic radiotherapy. (BBB)

26624 INTERACTIONS OF OXYGEN AT HIGH PRESSURE AND RADIATION IN DROSOPHILA. **Thomas, J. J. Jr.; Baxter, R. C.; Fenn, W. O. (Univ. of Rochester Medical Center, N. Y.). J. Gen. Physiol., 49: 537-49(Jan. 1966).**

Oxygen at high pressure (OHP) and x irradiation can interact in the fruit fly D. melanogaster to potentiate toxic actions characteristic of one agent alone. Thus, 1-MeV x irradiation in doses of 30, 60, and 75 KR accelerated the acute immobilization of young male Drosophila by oxygen at 7.8 atm, up to rates twice that observed with such oxygen pressure alone. Irradiation alone in these dosages did not acutely immobilize the Drosophila. Acute oxygen toxicity in young female Drosophila by 30- to 75-KR doses of radiation was augmented significantly by a concurrent 40-min exposure to high pressure oxygen, which alone did not significantly decrease life span. This shows that oxygen can affect not only the acute effects of radiation, but also the residual irreversible effects indicated by the life-span shortening. (BBB)

26625 INFLUENCE OF PHYSICAL AND CHEMICAL FACTORS ON THE IN VITRO RADIOSENSITIZATION OF RABBIT RED CELLS. **Bianchi, M. R.; Quintiliani, M.; Boccacci, M.; Strom, E. Minerva Radiol., Fisioterap. Radiobiol., 12: 56-61 (Jan.-Feb. 1967). (In Italian).**

Rabbit erythrocytes irradiated in vitro with x rays in doses ranging from 7 to 144 KR release their intracellular potassium content, during the three hours following the irradiation, in amount proportional to the radiation dose. Iodoacetic acid, sodium iodide, N-ethylmaleimide, ethyl methansulfonate and chloroform, all enhance to a great extent the radiation effect. Both the x ray effect and that of sensitizing compounds occur to the same extent when the red cells are maintained in nitrogen or oxygen atmosphere. The radiosensitization is inhibited by the presence in the system of proteins and amino acids. The most active inhibitors of the latter are: cysteine, cystine, tyrosine, methionine, and tryptophane. The sensitizing effect of N-ethylmaleimide can be only partially inhibited. The experimental results support the hypothesis that the sensitization is due to the effect of the radiolysis products of sensitizing compounds and that the inhibition is the result of the competition between the inhibitors and the structures of the red cell membrane versus the above mentioned products. (TSS)

26626 ORIENTATION OF PEROMYSCUS IN RELATION TO CHRONIC GAMMA RADIATION AND VEGETATION. **Bongiorno, Salvatore F.; Pearson, Paul G. (Rutgers Univ., New Brunswick, N. J.). Amer. Midland Natur., 72: 82-92(July 1964).**

Small mammals, particularly the white-footed mouse Peromyscus leucopus, were live-trapped, marked and released in an irradiated, natural oak-pine community at Brookhaven National Lab. The population was evaluated in the summer of 1961 prior to the start of daily irradiation in November 1961. The population was then studied in the summer of 1962 during irradiation. No detectable effects of radiation were observed in the population. Lack of detectable effects of irradiation was attributed to a low population density and too few animals with which to work, and a local nonrandom orientation of this species to certain parts of the irradiated forest which resulted in its being found in areas away from the source; that is, they were found where levels of radiation were mostly below 3 R day. It is evident that separation of effects of radiation from normal fluctuations in small mammal populations is only possible where the population can be followed by a number of years. (BBB)

26627 RADIOTHERAPEUTIC LUNG. **Duroux, P. (Hopital Bichat, Paris). Poumon Coeur, 22: 613-37(1966). (In French).**

The clinical details of six case histories are presented to demonstrate problems in the diagnosis of radioinduced lung injury. The literature pertaining to pulmonary pneumonitis and fibrosis following radiotherapy is reviewed, with 39 references to previous publications. The reported frequency of such lung lesions varies from 0 to 89%, depending on the radiotherapy technique used. Clinical and radiologic features of both early and late lung sequelae of irradiation are described. In four of the described cases, radiographic opacities of the lung followed radiotherapy within 6 months. In these early cases the lesions usually cleared up after corticoid therapy. Two cases represented late (>6 months postirradiation) sequelae. This more chronic form resulted in one case in respiratory insufficiency and serious attendant complications. The pathologic anatomy, pathogenesis, differential diagnosis, treatment, and prevention of these lesions are also considered. (BBB)

26628 DENTAL DEFECTS AFTER IRRADIATION AND THE SALIVARY GLANDS. **Frank, R. M.; Herdly, J.; Philippe, E. (Faculte de Medecine, Strasbourg). Actual. Odonto-Stomatol., 70: 129-55(June 1965). (In French).**

It was shown that the dental defects acquired after radiotherapy are manifested as a diffuse type of caries, initiated by drastic changes in the saliva and the salivary glands through irradiation of these structures. When the salivary glands are not in the field of irradiation, even if the jaws and teeth receive high doses, no dental defect develops. Therefore in the treatment planning for a carcinoma of the cervico-facial region, it is not necessary to extract teeth when the major salivary glands are outside the field of irradiation. If the salivary glands are irradiated, but the jaws and teeth are outside the field of irradiation, dental defects will develop. However, it is possible to extract teeth, with use of antibiotics, after the beginning of treatment, since alveolar bone has not been altered by the radiation. The most difficult situation consists in the direct irradiation of the salivary glands, teeth, and jaws: great caution must be exercised in these cases. (BBB)

26629 MECHANISM OF THROMBOCYTOSIS CAUSED BY ULTRAVIOLET IRRADIATION IN MICE. **Krizsa, F.; Cserrati, I.; Rak, K. (Univ. Medical School, Szeged, Hungary). Med. Pharmacol. Exp., 15: 539-44(1966).**

Mice, 3 to 4 months old, were exposed to uv radiation from a Hanau-type quartz lamp (20 V, 5.2 A) for 30 min at a distance of 0.5 m. Such uv treatment caused thrombocytosis, lasting for several days. Maximum thrombocytosis (an increase of 50 to 80% as compared to the original values) occurred on the fifth or sixth day; after this the number of circulating platelets decreased, then on the fourteenth to eighteenth day became normal again. The bone marrow was examined in both untreated and uv-treated mice on the 1st, 2nd, 3rd, 5th, and 8th days after treatment. There was no essential difference between the megakaryocyte indexes of the femoral bone marrow of treated and untreated mice. The average megakaryocyte index was 3.25 in the untreated group, 34.0 on the first day after uv treatment and 33.8 on the 2nd day. An increase in the number of megakaryocytes was noted on the first day (23.5); it was most pronounced on the 2nd day (33.4), later it became less, and on the fifth day it had a value (18.4) roughly the same as that of the control group (16.4). Thus, after uv treatment the number of the splenic megakaryocytes increases, while the number of the giant cells in the bone marrow remains essentially unchanged. The new megakaryocytes formed in the spleen must be responsible for the increased number of thrombocytes. Indirect evidence for this was found, namely, that thrombocytosis does not occur after uv treatment in splenectomized mice. (BBB)

26630 EFFECTS OF IONIZING RADIATION ON ENZYME LEVELS IN COW MAMMARY GLANDS. **Baldwin, R. L.; Willes, R. (Univ. of California, Davis). J. Dairy Sci., 49: 1223-5 (Oct. 1966). (UCD-34P129-2).**

Large doses of irradiation depress milk production and cause radionecrosis of mammary epithelium in cows. An attempt was made to determine whether the epithelial or alveolar damage is reflected by depression in the activities of enzymes which function in the synthesis of milk components. The forequarters of 5 heifers were irradiated with 500 R on the day they calved, using a ^{60}Co large-animal irradiator. Seven other heifers were irradiated with 1000 R an average of 12 days prior to calving. Biopsy samples were collected prior to irradiation, on the day they calved, and after 10 days of lactation. The second group received an additional 2000 R after 25 days of lactation and were slaughtered after 40 days of lactation. The results indicated that enzyme levels in mammary tissue were relatively unaffected by doses of irradiation up to 2000 R. However, there was a tendency for the activities of some enzymes to be affected about 1 day after treatment. For example, the activities of 6-phosphogluconate dehydrogenase, hexokinase, aldolase, and acyl-CoA dehydrogenase were lower, and the activities of the citrate cleavage enzyme and UDP glucose pyrophosphorylase higher, in the irradiated quarters. Between the 10th and 40th days of lactation activities of most of the enzymes studied, and levels of RNA in the mammary tissues, increased in both irradiated and control quarters. There were no apparent differences between the irradiated and control quarters 40 days after irradiation. (BBB)

26631 SYNTHETIC INHIBITORS AND NATURAL ANTI-OXIDANTS. II. ANTI-OXIDATIVE ACTIVITY OF LIPIDS OF THE MOUSE LIVER ON IRRADIATION AND THE RADIOPROTECTIVE EFFECT OF INHIBITORS OF FREE RADICAL REACTIONS. **Burlakova, E. B.; Dzyuba, N. M. (Inst. of Chemical Physics, Moscow). Biophysics (USSR) (Engl. Transl.), 11: 56-60(1966).**

Translated from Biofizika, 11: 54-7(1966).

Changes in the anti-oxidative activity of liver lipids of x-irradiated mice were studied. The anti-oxidative activity fell with development of radiation sickness. It was established that natural inhibitors were expended on irradiation as a result of their interaction with peroxide radicals, RO_2. It was shown that synthetic inhibitors of free radical processes injected into animals in doses raising anti-oxidative activity of liver lipids of animals exerted a radioprotective effect. Changes in the anti-oxidative activity produced by inhibitors of radical processes may apparently to some extent explain the extremal character of the dependence of percentage survival of irradiated mice on the dose of the inhibitor injected. (auth)

26632 STUDIES OF THE INFLUENCE OF TELECOBALT 60 IRRADIATION ON NORMAL AND TUBERCULOUS GUINEA PIGS AND OF THE INFLUENCE OF A COMBINATION OF BOTH TELECOBALT 60 IRRADIATION AND ANTI-TUBERCULOUS DRUGS ON TUBERCULOUS GUINEA PIGS. **Katagiri, Toshiro (Hirosaki Univ., Japan). Hirosaki Igaku, 18: 179-201 (Sept. 30, 1966). (In Japanese).**

Results are reported from studies on the influences of various doses of ^{60}Co γ radiation on the healthy and tuberculous guinea pigs. It was concluded that the ^{60}Co irradiation was not beneficial for the treatment of tuberculosis. (tr-auth)

26633 EVIDENCE OF A DEVELOPMENT DELAY OF DROSOPHILA MELANOGASTER BY DECREASE OF THE AMBIENT NATURAL RADIOACTIVITY. Planel, Hubert; Soleilhavoup, Jean-Pierre; Giess, Marie-Claude; Tixador, Rene (Faculte de Medecine, Toulouse). Compt. Rend., Ser. D, 264: 865-8(Feb. 6, 1967). (In French).

A series of studies were carried out on Drosophila melanogaster to determine whether the population decrease observed in populations protected from the natural radioactivity was caused by an interruption of development of embryonic or larval organisms or a general delay of the egg laying development. The results showed that the effect of radioprotection on the multiplication of Drosophila melanogaster was explained by the fact that a decrease of the ambient radioactivity caused a delay of hatching without causing the arrest of the embryonic or larval development. (J.S.R.)

26634 EFFECT OF A SECOND EXPOSURE TO X RAYS ON POST-IRRADIATION RECOVERY. **Littbrand, B.; Revesz, L. (Karolinska Medical School, Stockholm). Nature, 214: 841-2 (May 20, 1967).**

After mammalian cells have been x irradiated in vitro in the presence of oxygen, partial recovery from radiation injury can occur, but when such cells are irradiated under anoxic conditions there is no recovery. The purpose of the experimental work described was to ascertain to what extent, if any, the two types of damage interact. A Chinese hamster cell line was used as test material. Data are tabulated for survival after exposure to 400 R in oxygen or 800 R in argon, or to both in alternate sequence, with time intervals of 10 min or 18 hr; also for survival after exposure in argon or oxygen to either a dose of 1,600 or 800 R, or to the same dose in two equal fractions separated by a time interval of 10 min or 18 hr. A 10 min period was not sufficient for significant recovery to occur. Results indicated that no recovery occurs following anoxic irradiation; survivors were cells that escaped damaged. It is concluded that, probably because of the biochemical dissimilarity of the lesions produced, the total repair capacity of the cells is not shared in both forms of radiation treatment. (UK)

26635 EFFECTS OF DIETS ON THE MORTALITY OF MICE AFTER X-IRRADIATION (PRELIMINARY REPORT). Ueno, Y.; Sugahara, T. (Kyoto Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 26: 351-5(July 1966). (In Japanese).

A preliminary study was carried out on the effects of commercial diets without any special additive substances on the radiosensitivity of mice. Mice were x-irradiated and fed 3 kinds of diets; no significant differences in 30-day mortalities of mice were observed. Increased arginine and decreased methionine in the diet were accompanied by increased mortality. (TSS)

26636 EFFECT OF SUB-LETHAL GAMMA ON EGGS, EARLY, INTERMEDIATE, AND LAST INSTAR LARVAE OF THE ANGOUMOIS GRAIN MOTH, SITOTROGA CEREALELLA OLIV. **Qureshi, Zafar A.; Wilbur, Donald A. (Atomic Energy Agricultural Research Center, Tandojam, Pakistan). pp 112-24 of Proceedings of the Agricultural Symposium. Dacca, Pakistan, Atomic Energy Center, 1966.**

Irradiation of eggs of different ages showed that sensitivity declined as the eggs became older. Hatched larvae from eggs irradiated at age group 24—48 and 48—72 hours, treated with dosages of 10, 14, and 18 kR did not develop; in dosages of 2 to 6 kR the larvae developed normally. The adult emergence pattern after irradiation of the early and late first instar or the third and last instar revealed that irradiation delayed emergence and reduced the number emerged. Earlier stages were more sensitive than older ones. Structural deformities included twisted wings, fusion of antennal segments, fusion of tarsal segments, incomplete emergence and tumor formation in the abdominal region. (auth)

26637 SUSCEPTIBILITY OF ADULT RICE WEEVIL, SITOPHILUS ORYZAE (L.) TO GAMMA RADIATION. **Abdul Matin, A. S. M. (Atomic Energy Center, Dacca, Pakistan). pp 133-5 of Proceedings of the Agricultural Symposium. Dacca, Pakistan, Atomic Energy Center, 1966.**

An attempt has been made to find out the effects of gamma radiation on the adult rice weevil. The weevils were exposed to varying doses of radiation from 5 kR. All the doses could obtain 100% mortality within one month except 5 kR. (auth)

26638 ATTEMPT TO OBTAIN STERILITY OF MALE RICE HISPA THROUGH GAMMA RADIATION. **Abdul Matin, A. S. M.; Bhuiya, A. D.; Khan, Z. A. (Atomic Energy Center, Dacca, Pakistan). pp 155-6 of Proceedings of the Agricultural Symposium. Dacca, Pakistan, Atomic Energy Center, 1966.**

The adult male beetles were irradiated at various doses of gamma radiation at a fixed dose rate of 34.80 KR/hr and placed in cages with untreated females. Records were kept of egg production, hatch etc. When untreated virgin females were mated with irradiated males, the percentage of viable eggs decreased with an increase in dose. The average egg hatch in the untreated controls was 71.49% whereas matings with male beetles exposed to 10,000, 8000, 7000, 6000, and 5000 R showed averages of 1.4, 1.41, 9.3, 12.72, and 14.50% egg hatch respectively. (auth)

26639 TREATMENT OF CERVICAL CANCER IN A SMALL TEACHING HOSPITAL. **Kaiser, Irwin H. (Univ. of Utah, Salt Lake City). Amer. J. Obstet. Gynecol., 95: 330-8(June 1, 1966).**

Various aspects of use of radiation to treat uterine carcinoma are considered, including radiation injuries. In 6 yr, there have been 2 cases of serious irradiation injury. One patient manipulated the Ra containers so that a large overdose was delivered to the posterior vaginal wall. The patient developed a large rectovaginal fistula. The second patient also showed evidence of injury to the vagina. The lesion first developed as an indurated area in the posterior vaginal wall and then a rectovaginal fistula occurred through this. This patient subsequently also developed a vesicovaginal fistula. Because of steadily increasing induration in the pelvis and severe symptoms, a colostomy was done. This subsequently produced considerable bleeding and, the patient developed a fatal bowel obstruction. Death was attributed to irradiation injury, but review of the radium placement from the films did not produce evidence as to why this patient should have experienced so severe a degree of irradiation injury. These fistulas occurred in the only 2 patients in whom dosimetry was not carried out because the dosimeter was under repair at the time. (BBB)

26640 RADIATION EFFECTS ON RATS WITH YOSHIDA SARCOMA: VARIATIONS WITH TIME OF DAY. **Fochem, Kurt; Michalica, Werner; Picha, Engelbert (Univ., Vienna). Strahlentherapie, 132: 618-22(Apr. 1967). (In German).**

Differences of the radiation effect observed during the daily course in rats with Yoshida-sarcoma are reported. The sarcoma had been inoculated either intramuscularly into the thigh or intraperitoneally. As already observed in healthy rats and mice as well as in mice with Ehrlichs' sarcoma, a higher survival rate was found among the animals irradiated during the day time than in those irradiated at 9 p.m. The animals received a whole body irradiation of 1,500 R. That means, that an irradiation done at 9 p.m. is also considerably more effective in tumor-bearing rats. (auth)

26641 SKIN TRANSPLANTATION EXPERIMENTS FOLLOWING IRRADIATION WITH LARGE DOSES. **Zseboek, Zoltan; Petranyi, Gyoezoe Jr.; Bielawszky, Janos (Medizinsch-Radiologische Forschungsinstitut, Budapest). Strahlentherapie, 132: 584-93(Apr. 1967). (In German).**

Reactions observed in rats after the transplantation of skin patches are reported. Intact skin patches were transplanted to irradiated skin, and irradiated patches were transplanted to intact skin. The irradiation was done in both cases under short source skin distance conditions with doses of 3, 4, 5, 6, or 7 kR. It was observed that the intact skin patches stick perfectly after a process of gradual collagenization and necrotization of the accessory skin pieces in case of a minimal transplantation trauma and a radiation dose of 5 kR to the environmental tissue. The reaction was lighter and quicker when irradiated skin patches were transplanted to an intact environment. Irradiation with 6 kR caused necrosis of the transplanted skin patches or a simultaneous dying of the patches and the environment. (auth)

26642 THE SATURATION EFFECT IN RETINA MEASURED BY MEANS OF He-Ne LASER. **Blabla, J.; John, J. (Inst. of Radio Engineering and Electronics, Prague). Amer. J. Ophthalmol., 62: 659-63(Oct. 1966).**

By use of a He-Ne gas laser continuously operating at 6328 Å, experiments were conducted on the dependence between threshold coagulation doses and time of exposure. Measurements were made on retinas of gray chinchilla rabbits. An irreversible spot on the retina, becoming evident one min after exposure, was accepted as a standard for the threshold coagulation effect. The threshold values were obtained by averaging 4 or 5 exposures at the same output power and at different exposure times, and vice versa. The measurements suggested that retinal coagulation was possible with medium power gas lasers. One min after exposure a fine edematous spot was observed on the retina. Lesions produced above the threshold demonstrated more marked gray-yellow spots, most of which were craterlike. The laser energy was partially converted into an irreversible photobiologic effect (protein coagulation) and partially distributed in adjacent tissues by heat conduction. For short exposure times, heat conduction into adjacent tissues was very small, and almost all absorbed energy was converted into the coagulation effect. As the exposure time was increased, heat conduction increased, and threshold energy mounted. The heat equilibrium between the irradiated spot and the tissue was maintained from 500 msec on and the threshold energy was independent of the exposure time. For diameters of image sizes less than 100 μ, a saturation effect took place between incident energy and exposure time. For image diameters around 70 μ, a saturation threshold energy density of ~45 J/cm^2 was obtained. (BBB)

26643 RADIATION DERMATITIS AND MALIGNANCY. **Conway, Herbert; Hugo, Norman E. (New York Hospital, N. Y.). Plast. Reconstr. Surg., 38: 255-68(Sept. 1966).**

Observations were made on 126 patients with postradiation dermatitis in the 31-yr period from 1932 to 1962. Most were seen in the third decade of this study because of the long period between exposure and development of postradiation dermatitis and malignancy, and more importantly, to the radiation therapy which is now employed so widely. Sixty-three patients had been treated for malignant disease and all had suffered radiation injury, either in the treatment of benign lesions or accidentally. The 100 patients suffering from radiation dermatitis without malignant degeneration were grouped into categories of mild (52 patients), moderate (15 patients), and severe (33 patients) postirradiation dermatitis. The dose causing these specific degrees of radiation dermatitis and the latent periods for each group are tabulated. About 5% of the patients treated for malignant disease and 36% of the patients injured during the treatment of benign lesions (or accidentally) exhibited malignant degeneration. Sixty cutaneous carcinomas developed in the 23 patients who developed cutaneous malignancy after irradiation of benign lesions. Sixty % were basal cell carcinomas and 40% were squamous cell carcinomas. Basal cell carcinoma developed 5 yr later, on the average, than did squamous cell carcinoma. Surgical excision and repair were preferred treatments for postradiation malignancy. Management of specific cases is reviewed. After surgery, usually in multiple stage procedures, there were no deaths attributable to postradiation malignancy during the follow-up period of 5.2 yr on the average. (BBB)

26644 CLINICAL EFFECT OF X IRRADIATION ON THE SKIN OF CATTLE. Bolz, W. (Institut fuer Tierheilkunde, Stuttgart). Zentralbl. Veterinaermed., 11: 343-57(June 1964). (In German).

After a review of the radiation reactions which have been observed in the skin of humans and various animals, studies were conducted on calves, young bulls, and cows (up to the age of 12 yr) by x irradiation (70 kv) of 20 × 20 cm fields of the chest wall. The course of the reaction was accelerated with increasing doses. Doses of 953 to 2480 R were used. The age of the animals had a perceptible influence on the intensity of the reaction. The induration of skin lasted for 6 to 16 weeks at which time the pigmentation was slowly returning. With higher doses, permanent epilation, hyperkeratosis, and pachydermia resulted. (BBB)

26645 EFFECT OF FRACTURED MANDIBLES AND OTHER INJURIES IN RADIATION SICKNESS. Sicha, Vladimir (Charles Univ., Hradec Kralove, Czech). Cesk. Stomatol., 65: 198-202 (1965). (In Czech).

The effect of fracture of the jaw and thigh bone on the lethal effect of x radiation was studied in 160 Wistar rats. The rats, of average weight 186 g, were exposed to 450-R or 600-R, whole-body doses of 180-kv x rays. Under anesthesia the bones were broken and the survival time of the animals was followed for 30 days. The mean survival time of 450-R irradiated controls was 30 days, that of irradiated rats with thigh bone fractures 26 days, and that of irradiated rats with jaw bone fractures 22 days. The corresponding percentages for animals surviving for 30 days in these 3 groups were 100%, 60%, and 20%. For the 600-R groups without fractures, with thigh and with jaw fractures the mean survival times were 23, 18, and 8 days. The corresponding percentages of rats surviving 30 days in these three 600-R groups were 55, 40, and 0%. These results indicate that fractures of leg and jaw bones increase the severity of radiation disease, mandibular fractures being more serious in this regard. This may result from the contamination of the jaw lesions by the oral bacterial flora. (BBB)

26646 INFLUENCE OF SMALL DOSES OF IONIZING RADIATION ON THE RESPIRATION RATE IN CHICKEN EMBRYO. **Zubareva, L. A.; Kuznetsov, N. I. Tr. Inst. Genet., Akad. Nauk SSSR, No. 31, 319-29(1964). (In Russian).**

A study of the rate of the respiratory gas exchange during irradiation of eggs from White Russian variety of chickens with small doses of γ radiation (10.5 to 21 mR) showed that the respiratory exchange proceeded very actively in irradiated eggs. The consumption of O_2 in the test embryos proceeded more actively than in controls, in the first series of tests an increase of from 0.9 to 19.2%, in the second series from 4.6 to 48.4% and in the third from 1.8 to 29.1%. The evolution of CO_2 and the heat production are just as high in the test eggs. The greatest differences in the respiratory exchange was observed on the 15th to 16th day of incubation; in the closing period of incubation these differences decreased. The respiratory coefficients in the test and control groups were very similar, which indicates the absence of pathological changes in the respiration of embryos during irradiation of eggs with small doses of γ rays. Changes of the respiration rate under the effects of irradiation depend both on the length of incubation of the egg and on the irradiation dose. Irradiation does not show any effects on the gas exchange rate of day-old and month-old chicks. The duration of the embryonic period in test and control groups does not differ significantly. (tr-auth)

26647 A STUDY OF PATHOLOGICAL CONDITIONS IN WILD RODENTS IN RADIOACTIVE AREAS. **Childs, H. E. Jr. (Cerritos Coll., Norwalk, Calif.); Cosgrove, G. E. Amer. Midland Natur., 76: 309-24(Oct. 1966). (ORNL-P-1401).**

Techniques for the diagnosis of radiation damage in the small mammals were sought by a pathologic, hematologic, and parasitologic survey of the rodents Peromyscus leucopus leucopus, Sigmodon hispidus komareki, and Oryzomys palustris palustris living in the radioactive bed of the former White Oak Lake (Oak Ridge, Tenn.). The lake, used for 12 yr as a settling basin for radioactive wastes, was drained and the soil of the bed contained various radionuclides, augmented by ground seepage of isotope-contaminated wastes from nearby waste-disposal pits. Controls came from uncontaminated sites. The studies included length measurement, body weight, spleen and adrenal weights, gross and microscopic necropsy examination, determination of packed red cell volume and differential leukocyte count, and collection of parasites. No significant differences attributable to exposure to radiation were seen. Many lesions were encountered at necropsy of the animals, but they were usually incidental findings not seriously threatening the health of the host. There was a wide range in hematologic values probably due in part to differing incidental disease and parasite burdens. The presence of Cuterebra larva in P. leucopus led to significant reduction in the hematocrit. There was a high incidence of parasitism in all 3 rodent species, but associated pathologic changes were not serious in most instances. It appeared that diseased animals are rapidly removed from the wild populations and not ordinarily recovered in such a study. The levels of radiation exposure were probably too low to result in somatic effects in exposed animals during their short life in the wild. (BBB)

26648 EXPERIENCE WITH HIGH ENERGY ELECTRON BEAM THERAPY. **Botstein, Charles; Schulz, R. J. (Montefiore Hospital, New York). Progr. Radiat. Therapy, 3: 27-49 (1965).**

Some radiobiologic aspects of fast electron therapy are considered, particularly by comparison with properties and effects of other radiations, and some experimental and clinical studies with high-energy electrons are reported. A table shows the variation of RBE values (0.69 to 1.0) with 18- to 35-MeV electrons for various animal species. There are indications, based on both physical considerations and clinical observations, that electron beams are biologically more effective near the end of their path of penetration. The results of 4 studies designed to detect differences between RBE at surface and depth in unit density phantoms are examined. Studies, in which mice were irradiated at the surface (100%) and phantoms at a depth of 11 cm (60%), failed to show any difference in RBE. Three of the 4 experiments failed to show a change in RBE; however, the striking increase found in Drosophila studies indicates the need for further experimentation. Clinical experience suggests that the observable tissue reactions differ both qualitatively and quantitatively from those produced by conventional x rays. Even if an RBE value of 0.8 is used, skin erythema is less severe and of shorter duration than that produced by equal doses of orthovoltage x rays. Examples are shown of the severity and duration of erythema produced by electron beam treatments. Various aspects of dosimetry, and particularly the problem of output standardization of high-energy electron accelerators in terms of dose delivered at the dose max in a phantom composed of tissue equivalent material, are discussed. The following advantages of fast electron therapy are examined: (1) controlled depth dose resulting in a low integral dose, (2) good tumor response with high tolerance of the surrounding healthy tissue, and (3) convenience of application because of the simplicity of the treatment planning by the use of a single field. (BBB)

26649 CEREBRAL EDEMA AFTER LASER RADIATION: AN ELECTRON MICROSCOPIC STUDY. **Lampert, Peter W. (Inst. of Pathology, Washington, D. C.); Fox, John L.; Earle, Kenneth M. J. Neuropathol. Exp. Neurol., 25: 531-41(Oct. 1966).**

The electron microscopic appearance of the edematous brain 1 and 24 hr after laser irradiation of low intensity, and the spread of an intravenously injected electron-dense tracer (colloidal ThO_2) throughout the edematous brain are described. A ruby laser (6943 Å) was used, with 1-msec pulses of 10 J or less. About 20% of the energy of the beam focussed on the exposed skull of the rat was transmitted to the surface of the cerebral cortex, amounting to about 200,000 W/cm^2. The intense, transient heat generated by this energy in a focal point not only coagulated but also vaporized tissue. The sudden compressive force of this explosive vaporization caused disruption and necrosis of the cerebral cortex with hemorrhages underneath the impact point. The edema surrounding the area of focal cortical necrosis consisted of swelling of astrocytic processes without much widening of intercellular spaces, which differed from findings in the white matter, in which a striking enlargement of extracellular spaces was noted 24 hr after irradiation. Thorotrast, injected intravenously prior to irradiation, escaped from disrupted vessels in the necrotic center of the lesion but did not transverse vessel walls in the edematous brain. Thorotrast spread from the area of necrosis into the surrounding edematous tissue. Narrow intercellular spaces in the edematous cortex were limited but did not prevent the diffusion of Thorotrast particles. Glycogen accumulated within astrocytes in the edematous cortex, but not in white matter. Large axonal enlargements filled with mitochondria, vesicular elements, and dense bodies were observed in the edematous subcortical white matter. Such axonal swellings are known to develop after injury to axons, notably after axonal section. (BBB)

26650 X-IRRADIATION OF THE DROSOPHILA MALE AND ITS EFFECT ON THE NUMBER OF SPERM TRANSFERRED TO THE FEMALE. **Zimmering, S.; Fowler, G. (Brown Univ., Providence, R. I.). Z. Vererbungsl., 98: 150-1(1966).**

Experiments were carried out to determine the number of sperm transferred by the male Drosophila after irradiation, with 5000, 25,000, and 50,000 R acute doses (1000 R/min) of x radiation. Reductions were 20 to 25%, 60 to 65%, and 85 to 90%, respectively. Thus, at a dose (5000 R) used in many radiation experiments, a significant proportion of sperm failed to be transferred. Some aspect of sperm behavior, possibly motility, may have been affected by x radiation. An unexplained result from these experiments was that the proportion of sperm in the spermatheca was greater at higher doses of x radiation. Preliminary experiments suggested that this was related to the small size of the ejaculate, and not to the effect of the x rays. Sperm in ejaculates of relatively small size (under 50) from unirradiated males were observed to distribute themselves such that 20 to 50% or more were observed in the spermathecae. Should the mean percent of sperm in the spermathecae turn out to be on the order of 50% or so from ejaculates of 50 sperm or fewer, it could account for the apparent 1 : 1 sperm : progeny ratio previously reported from ejaculates of this size. In earlier experiments, only sperm in the ventral receptacle was scored. (BBB)

26651 EXPERIENCES IN THE TREATMENT OF PAPILLOMATOSES IN CHILDREN. **Riccabona, A. v. Arch. Ohren-, Nasen-, Kehlkopfheilk., 185: 697-9(1965). (In German).**

In children 10 yr following removal of papillomas who were treated with 4500 R or less, perichondritis was observed particularly in the ring cartilage plate. This tended to produce obliteration of the larynx requiring tracheotomy. In one case an esophageal fistula developed that required total extirpation. Injuries were observed in children after administration of 2000 R, even though no perichondritis was present. Examination of the larynx showed that the cartilage was extremely thin, soft, and severely damaged. Children should not be treated with x ray or Ra irradiation for laryngeal papillomatoses. (BBB)

26652 THE TRANSPLANTATION EFFICIENCY OF MARROW COOLED TO -100 DEG C AT 2 DEG C PER MINUTE. **Lewis, Jerry P.; Passovoy, Mitchell; Trobaugh, Frank E. Jr. (Presbyterian-St. Luke's Hospital, Chicago). Cryobiology, 3: 47-52 (1966).**

A technique for freezing and thawing murine bone marrow, which was demonstrated to be highly efficient in marrow repopulation in irradiated hosts, is described. The mouse bone marrow was cooled to −100°C at a rate of 2°C per min, freezing being initiated at −12°C. After it was thawed, its repopulating potential, as estimated by the hematopoietic colony technique in 750-R irradiated mice, was 95% of its value prior to freezing. These are the first studies in which this degree of precision in measurement and of efficiency in the preservation of viable mammalian cells has been demonstrated. This represents a high efficiency considering the many physiochemical processes these cells undergo during the process of freezing and thawing. If human hematopoietic cells respond similarly, and there is no evidence either that they will not, the means for preserving human marrow for indefinite periods of time are at hand. (BBB)

26653 COMPARATIVE ELECTRON MICROSCOPIC STUDIES OF EARLY IRRADIATION CHANGES IN EHRLICH ASCITES TUMOR STRAINS OF VARIED RADIATION SENSITIVITY. **Stegner, Hans-Egon (Univ., Hamburg). Geburtsh. Frauenheilk., 26: 818-26(May 1966). (In German).**

Animals injected 3 to 4 days previously with ascites tumor cells were irradiated in the abdominal area with 2000 R of 200-kv x ray. At this stage of development the necrotic index is low, and few cells have died, but tumor growth is exponential. The animals were killed at 30 min, 2, 4, 6, and 14 hr after irradiation, and the isolated tumor cells prepared for study with the electron microscope. No definitely regressive changes were observed in the ascites cells taken from animals 30 min after irradiation with 2000 R. However, there were some indications of increased metabolic activity that may have been a compensatory effect of the irradiation. In the cells removed 2 hr after irradiation there was a definite regression of the ergastoplasm, suggesting an early type of radiation injury. The mitochondria and nuclear apparatus were rather insensitive to the radiation dose used. Most of the other cytoplasmic structures appeared to be severely damaged in the cells removed 14 hr after irradiation, although the mitochondria remained comparatively unaltered. In the course of generalized recovery the total number of organelles was reduced. (BBB)

26654 THE CASE FOR PARTIAL LARYNGECTOMY IN PREFERENCE TO RADIATION FOR LOCALIZED CORDAL CAR-

CINOMA. Jesberg, Norman (Univ. of Southern California, Los Angeles). Laryngoscope, 76: 1247-53(July 1966).

Failure of radiation to sterilize cancer and a high incidence of complications are cited as reasons that localized cordal carcinoma can be treated with equal success by modern radiological methods or partial laryngectomy. Observations indicate that radiotherapy is too often cancerostatic and not cancerocidal. Recurrences both before and after the customary five-year observation period were encountered. Late adverse effects observed in patients receiving radiation included the appearance after 5 yr of aplastic anemia, cicatricial stenosis, and separate carcinomas within the field of radiation. The latter have generally taken up to ten yr for their development. Lesions were observed in the thyroid gland and in other parts of the larynx and hypopharynx. Some of these have been considered to be radiation induced. Adverse effects of radiation in more voluminous growths were reported. Recurrences may develop after partial laryngectomy but the recurrence rate is considerably lower than in similar cases treated by radiation. A case of localized cordal carcinoma, initially suitable for partial laryngectomy, which was treated radiologically is described. Nearly 6-yr after radiation treatment, laryngetomy was performed. Extensive cordal carcinoma with periarytenoid infiltration was found. (BBB)

26655 THE DEVELOPMENT OF MULTIPLE THYROID ADENOMATA IN PRIMARY HYPERTHYROIDISM IN PREVIOUSLY IRRADIATED THYROID GLANDS. Doniach, I.; Eadie, Douglas G. A.; Hope-Stone, H. F. (London Hospital). Brit. J. Surg., 53: 681-5(Aug. 1966).

Three case reports of primary hyperthyroidism are presented in which pathology of the thyroid gland showed, in addition to diffuse hyperplasia, an unusual number of grossly bizarre nuclear forms and multiple small adenomas of varied morphology. Each patient had been given x-ray therapy years previously for treatment of carcinoma of the breast. The appearance of the thyroids was strikingly similar to that seen in rats maintained on goitrogen after an initial dose of x rays or radioiodine. These findings suggest that in the human, as in the rat, thyroid tumors may result when hyperplasia supervenes in a previously irradiated gland. In the rat experiments, carcinomas developed after a longer interval than the adenomas so that it is possible that the thyroid change seen in this series represents a premalignant condition. It was difficult to assess the radiation dose to the thyroid in the patients reported above given x-ray treatment for carcinoma of the breast. It is suggested that the adult human thyroid is susceptible to the carcinogenic action of comparatively small doses of therapeutic irradiation when the gland undergoes subsequent hyperplasia. It is further suggested that, when primary hyperthyroidism occurs in a patient known to have had previous irradiation to the lower neck, treatment with antithyroid drugs should be avoided, unless covered with thyroxine in order to prevent increased thyrotrophic hormone (TSH) secretion. Maintenance on thyroxine would equally be recommended if subtotal thyroidectomy or ^{131}I therapy were alternative treatments chosen, but the production of the longacting thyroid stimulator that occurs in untreated or treated primary hyperthyroidism will continue for a long time, possibly years, in spite of thyroxine treatment. The risk of malignant change in the thyroid could be totally eliminated by complete ablation of the thyroid with radioiodine. (BBB)

26656 LEUKEMIA FOLLOWING RADIOIODINE TREATMENT OF THYROTOXICOSIS. Pochin, E. Eric (Univ. Coll., London). Brit. Med. J., 2: 1545-50(Nov. 26, 1960).

A survey was made of the incidence of leukemia in ^{131}I-treated subjects in the United Kingdom by means of questionnaires sent to hospitals. Results were compared to those of similar surveys in other countries. Leukemia developed in 18 patients who were previously treated with radioiodine for thyrotoxicosis, three cases having occurred in the United Kingdom, ten in the United States, four in Canada, and one in Austria. About 60,000 thyrotoxic patients were treated with radioiodine in these four countries alone, with an estimated total of over 220,000 patient-yr since treatment until mid-1960. Comparison with natural leukemia rates appropriate to the sex, age, and nationality of these patients suggested that an average of 21 cases of leukemia would be expected to have occurred fortuitously among them whether radioiodine had been given or not. Of the 17 cases in which the type of leukemia was known, 13 were diagnosed as acute, a proportion higher than that expected. Thus, the present known records of cases in which leukemia has followed radioiodine treatment of thyrotoxicosis do not indicate that this treatment induces leukemia. (BBB)

26657 CASE RECORDS OF THE MASSACHUSETTS GENERAL HOSPITAL. CASE 29-1966. Castleman, Benjamin (ed.) (Massachusetts General Hospital, Boston). New Engl. J. Med., 274: 1499-502(June 30, 1966).

The case history of a 60-yr-old woman is presented who developed radiation injury (ileitis, with stenosis and ulceration) 16 yr after radiotherapy for cervical cancer. The course of x-ray therapy was directed to the pelvis, providing an estimated dose of 4150 R. Two weeks later she received Ra implantation (3900 mg-hr). She remained well for 9 yr. However 16 yr postirradiation she began to experience episodes of epigastric pain that radiated posteriorly and was relieved by vomiting. There was no evidence of local recurrence of cancer in the pelvis; therefore, it seemed probable that the symptoms were due to radiation reaction. At operation the pelvis was found to be full of adhesions. Loops of bowel were adherent in the pelvis, and as the dissection progressed it became clear that radiation damage of the distal ileum had occurred. The remainder of the small bowel was greatly dilated but not involved in the radiation reaction. The finding of reddening and adhesion of the sigmoid colon indicated that it had been damaged also. It was necessary to resect about 30 cm of the terminal ileum because a perforation might occur if the bowel was shortcircuited. A colostomy was not done in the hope that the radiation reaction in the sigmoid colon would subside after the small bowel was resected. Histologic examination of the resected ileum revealed an ulcer, 6 mm in dia, in the region of the stenosis. (TSS)

26658 PREVENTION OF RADIO-OSTEOMYELITIS IN THE MANDIBLE AND MAXILLA. Conn, J. Harold; Fain, William R.; Farrell, G. W.; Sloan, Robert D. (Veteran's Administration Center, Jackson, Miss.). Surg. Gynecol. Obstet., 123: 114-6 (July 1966).

Attempts were made to determine how soon radiotherapy can be started after tooth extraction without failure of gingival healing or dental alveolus necrosis. The time interval may be of importance. The length of time necessary to cause avascularity may be longer than for immediate gingival healing. To examine this question, three left lower molar teeth were removed from 20 dogs that were then given ^{60}Co teletherapy in 500 R doses to 4500 R to the left lower gingiva. All dogs were fed a ration that required little chewing. Complete gingival healing occurred in an average time of 16.5 days in the control and in the irradiation group 21 days. In spite of this delay in healing, radio-osteomyelitis of the mandible did not develop in the 5-yr observation period. These results indicate that although immediate irradiation does cause a significant delay in wound healing in dogs, the gingiva eventually heal without evidence of tooth socket necrosis. This suggests that radiation therapy can be started immediately after tooth extraction without fear of wound healing failure. On the basis of results of these experiments, ^{60}Co teletherapy was begun immediately (0 to 1 day) following tooth extraction in five patients with rapidly growing intraoral epidermoid carcinoma. The ^{60}Co therapy was supplemented in two cases with the implantation of 1 mCi Rn seeds. Total dose ranged from 5000 to 8000 R given through two lateral ports. Gingival healing time was normal in all patients. Radio-osteomyelitis developed in only one patient and this was on the side opposite to the carcinoma. It is imperative that all teeth in the direct path of the radiation be extracted. Follow-up for 6 months to 5 yr showed evidence of radio-osteomyelitis. (BBB)

26659 LATE EFFECTS IN CATTLE EXPOSED TO RADIOACTIVE FALLOUT. Brown, Daniel G.; Reynolds, Robert A.; Johnson, Donald F. (Univ. of Tennessee, Oak Ridge). Amer. J. Vet. Res., 27: 1509-14(Nov. 1966).

Sixty Hereford cattle unintentionally exposed to radioactive fallout from the first atomic bomb test in July 1945, were studied for several years postexposure. The radiation dose was estimated to have been 150 R of penetrating radiation and 37,000 RAD of β radiation to the surface of the skin over the dorsum. Because of anaplasmosis, most of the herd was destroyed, and only 11 cows survived after 1951. The last cow died in November, 1964. During 114 possible breeding years beginning in 1948 for the 11 cows, 94 calves were weaned. Four calves that were normal at birth died before weaning, and two were born dead. The average weaning weight of the calves at 240 days of age was 222 kg. The significant damage associated with irradiation was areas or zones of hyperkeratosis in the form of plaques and cutaneous horns on the skin of the dorsum. These lesions were presumably caused by β radiation (β burns). Three cows that survived 15 or more years postirradiation developed squamous-cell carcinoma of the skin at the site of the irradiation lesions. The probability that these neoplasms were related to irradiation is minimized by the inclination of the Herford breed to develop this type of malignant growth on or near the eyes, and by the age of the cattle at the time of tumor development. The squamous-cell carcinomas that developed in the skin on the backs of three cows at the site of β burn lesions probably would not have developed had there not been such lesions. The incidence and nature of infectious diseases were similar to that among nonirradiated controls. The breeding efficiency and health and growth of offspring were equal to, or above, average. (BBB)

26660 VARIATION IN THE CONTENTS OF SULFHYDRYL GROUPS IN EXTREMITY TISSUES OF AXOLOTL, ACCOMPANYING INHIBITION OF THEIR REGENERATION CAPACITY BY X RAY IRRADIATION, AND OF ITS RESTORATION. **Teplits, N. A.; Kilina, S. P. (Inst. of Animal Morphology, Moscow). Dokl. Akad. Nauk SSSR, 171: 1209-12(Dec. 11, 1966). (In Russian).**

The sulfhydryl (SH) content was investigated in axolotl extremity tissue after amputation under the following conditions: (1) without irradiation, when the extremities were being rengenerated, (2) after an x ray dose of 8000 R to the rear extremities (this dose resulted in suppression of the regenerative capacity of the extremity), and (3) after irradiation with the same dose, and recovery of the suppressed regenerative capacity by injections of freshly-prepared RNA into the animal. The SH content of the tissues was determined 1, 5, 10, 15, 20, 30, 60, and 90 days after amputation. The results showed that protein synthesis in the irradiated tissues was different from that in the controls. Even at the end of 90 days the SH content of the protein fraction was lower in the irradiated tissues, while the SH content of the nonprotein fraction was higher in the irradiated animals than in the controls. (TTT)

26661 A LIGHT AND ELECTRON MICROSCOPIC STUDY ON THE EFFECTS OF ^{60}Co IRRADIATION ON THE FOLLICULAR DEVELOPMENT IN THE ALBINO RAT. **Rochowiak, Michael William. Lincoln, Neb., Univ. of Nebraska, 1966. 117p. Thesis.**

Serial sections of ovaries from Holtzman rats subjected to 300 R ^{60}Co gamma rays delivered at a rate of 50 R/min. revealed that whole body irradiation (Exp. I) and irradiation to the ovarian region only (Exp. II) caused a two-thirds reduction in the number of primordial follicles and a concomitant doubling of the number of mature vesicular follicles. This was statistically significant ($P > 0.005$) using Student's t test. Primary follicles decreased in number ($P > 0.05$) while the immature vesicular follicles increased ($P > 0.50$). The number of secondary follicles showed no change compared with the controls. Both Exp. I and Exp. II gave very similar results. Irradiation to the head region only (Exp. III) caused no change in number of any type follicle compared with the control animals. Irradiation evidently produced some change directly within the ovaries which caused a shift toward the more mature follicular type. This shift may have resulted from the radiation induced reduction in number of primordial follicles causing an increase in the ratio of gonadotrophic hormone to the remaining primordial follicles. Once established, this shift remained constant throughout the sixteen estrus cycles studied. There were no indications that sterility was imminent. Oogenesis apparently was produced at a rate sufficient to counterbalance the shift to the more mature distribution pattern and to maintain a constant number of primordial follicles. The germinal epithelium of normal ovaries contained large, rounded cells presumably indicative of active oogenesis. Post-pubertal oogenesis was apparent from serial sections of an ovum with its follicular cells forming within the germinal epithelium of an irradiated animal. Electron micrographs support this concept, since it was shown that one of the presumed germinal epithelial cells with a characteristically indented nucleus appeared adjacent to a primordial ovum immediately beneath the tunica albuginea. Electron microscopy revealed no differences between irradiated and control immature vesicular follicles. These follicular cells were characterized by rod shaped mitochondria with transverse parallel cristae, undilated granular endoplasmic reticulum and free ribosomes distributed throughout the cytoplasm with a tendency to form rosettes. A Golgi complex was frequently seen. In contrast to the immature vesicular follicles, the granulosa cells of the mature vesicular follicles showed a highly dilated, agranular endoplasmic reticulum. Many mitochondria appeared to have tubular cristae. No Golgi complex was seen, but free ribosomes were observed. Because of the tremendous amount of dilated endoplasmic reticulum the cell appeared lacy and the mitochondria appeared to be in contact with the endoplasmic reticulum on all sides. The irradiated animals appeared to have more granulosa cells with dilated endoplasmic reticulum than did the control animals. Electron micrographs of the developing corpus luteum showed cells with mitochondria having cristae with a definite tubular appearance. The agranular endoplasmic reticulum appeared reduced in volume. There were two types of electron dense fat droplets; the F1 type was membrane bound and oval, while the F2 type was amorphous with no demonstrable membrane. Some F2 type droplets appeared within several mitochondria. There was an apparent spatial relationship between agranular endoplasmic reticulum, mitochondria, and fat droplets. Because these prominent changes occurred at estrus under the influence of gonadotrophic hormones, it was postulated that these hormones may have altered DNA-RNA synthesis which altered enzyme production, resulting in the elaboration or change in ovarian hormonal biosynthetic pathways. Phagocytosis was characteristic of the granulosa cells of immature vesicular follicles of both irradiated and control ovaries. (Dissertation Abstr.)

Radiation Effects on Plants

Refer also to abstracts 26348, 26378, 26392, 26394, 26396, 26501, and 26710.

26662 (ORO-3114-5) EFFECT OF SELECTION ON RADIOSENSITIVITY. Final Report, June 1, 1963–May 31, 1967. Pfahler, P. L. (Florida Agricultural Experiment Station, Gainesville). Contract AT(40-1)-3114. 36p. Dep. CFSTI.

Results are summarized from a study on the effect of genetic selection on the γ radiosensitivity of maize, using the number of kernals in plants produced by an individual within any population as the ultimate expression of fitness and adaptation. Alteration of kernal number by irradiation was selected as the criteria of radiation damage since this is probably the result of nuclear and chromosomal damage and is considered a reliable test of how the populations will withstand exposure to γ radiation. Seeds from inbred parents, that had shown a distinct differential response to increasing dosages of γ radiation in earlier tests, were exposed to 0, 4, 8, 12, 16, and 20 KR of γ radiation and plants grown from these seeds were interpollinated and plants grown from irradiated seeds from the next two generations were examined for selection for radioresistance. Results indicated that radiosensitivity is a highly complex trait, quantitative in nature and greatly influenced by environment. Data are presented from studies on the effects of moisture content of the seeds at the time of irradiation on radiosensitivity; the effect of radiation dose delivered to seeds on the percentage of plants reaching reproductive maturity and producing seeds; meiotic abnormalities and irregularities associated with differential radioresistance; and chromosome damage induced by various levels of γ irradiation. A technique was developed for in vitro germination of maize pollen. Selection for radioresistance was characterized by relatively small gains under the experimental conditions used. (C.H.)

26663 CHLOROPLAST DIFFERENTIATION FOLLOWING GENE INDUCED PLASTOM MUTATION IN ARABIDOPSIS THALIANA (L.) HEYNH. **Roebbelen, Gerhard (Univ., Goettingen, Ger.). Z. Pflanzenphysiol., 55: 387-403(Sept. 1963). (In German).**

X irradiation of immature pollen with a 32-KR dose gave rise, among 312 green plants in the second generation, to 96 plants with green-white variegated rosette leaves. It was found that the nuclear gene albomaculans (am) in homozygous recessive condition gives rise to leaves of this type. This variegation was inherited, indicating that the gene am induces plastom mutations. By backcrossing, the phenotype of the mutated white plastids was shown to be maintained independent of the nuclear genotype for at least 4 plant generations. At the border between white and green leaf sectors, mutated and normal green plastids occurred side by side without intermediate phenotypes within individual mixed cells. In the progeny of these heteroplastidic cells a sorting out of both plastid types was indicated by the macroscopic pattern of the variegation. The substructure of the chloroplasts in the palisade cells was examined by electron microscopy. The plastom mutation apparently blocks the thylakoid differentiation at an early phase. In homoplastid white cells the plastids contained only some vesicles and osmiophilic globules within their matrix. In mixed cells, however, large prolamellar bodies and even thylakoids were formed in the mutated plastids. No phenotypic difference was detected between the inhibited plastids of this plastom mutant and those of some nuclear gene mutants of Arabidopsis investigated earlier. In mixed cells with only 1 or 2 unmutated chloroplasts the latter exhibited a distinct reduction of their thylakoid systems. The nature of this interaction between the mutated and normal plastids within 1 cell is still unknown. The x-ray-induced mutation of the plastids was directed by the am gene: only 1 specific phenotype was recovered. The genetic substance of the plastids is presumably DNA. To explain the directed mutation of this plastom DNA, it is suggested that the mutator substance produced by the am gene is RNA. (BBB)

26664 STUDIES ON THE UPTAKE OF CESIUM BY ISOLATED BARLEY ROOTS. **Marschner, H. (Landwirtschaftliche Hochschule, Stuttgart). Z. Pflanzenernaerh. Dueng. Bodenk., 95: 30-51(1961). (In German).**

In short-term studies of 5-min duration the initial phase of uptake of Cs labeled with ^{134}Cs by living barley roots at 0°C and dead barley roots maintained at 20°C consisted of a nonspecific non-metabolic exchange adsorption. Competition between various ions for adsorption sites was governed by their position in the lyotropic series. Adsorption of Cs was exceeded only by alkaline earth ions. A second type of adsorption that appeared to be related to metabolic processes and required the presence of K or Rb was also observed. Uptake of Cs was temperature dependent. It appeared to be closely related to metabolic processes, being inhibited by 2,4-dinitrophenol. Uptake of Cs was ~50% higher in the tips of the roots as compared to the basal zones. At Cs concentrations less than 5 meq/l, Cs uptake was increased by addition of Li, Mg, Ca, and Sr, and decreased by addition of Na, NH_4, K, or Rb. In the absence of Ca the inhibitory effect of K at high Cs concentrations decreased, but with Ca it remained constant. At Cs concentrations greater than 5 meq/l Ca was not required for any inhibitory effect, suggesting an increasing proportion of passive Cs uptake at high Cs concentrations that was unrelated to presence of K. It did not indicate a second uptake mechanism for Cs at high concentrations. Competition of K or Rb with Cs was ~ equal. These results suggested competition for the same specific adsorption sites. Both K and Rb had an 8 fold greater affinity for binding sites than Cs did. For this reason 2 or 3 times as much K or Rb was taken up, as compared to Cs. The inhibitory effects of Na, NH_4, K, Rb, and Cs on ^{134}Cs uptake were greater than their inhibitory effects on Rb uptake, probably because of the lower affinity of Cs for available binding sites. The uptake of ^{134}Cs was similar in both isolated or intact barley roots. (BBB)

26665 CHIMERAL STRUCTURE OF MUTATED SECTOR INDUCED BY CHRONIC EXPOSURE ON GROWING BARLEY. **Yamashita, Atsushi. Radioisotopes (Tokyo), 16: 110-16(Mar. 1967). (In Japanese).**

Under chronic exposure of ionizing radiation on the growing barley plants for long term, size of mutated sectors induced in a spike would vary from a whole spike to only one spikelet as a unit of screening. But it may be reasonably assumed that mutations in a spike are included much more at the later stage of the development because of their more initial cells of the spike. Therefore, a peak of the variation of the mutated sector size is expected to be found at the smallest unit. Experimental results showed that almost all the mutants were found as one plant in an M_1 spike progeny or as one segregating line in M_3 family. The following three patterns were classified according to the ascertainment of mutations $M_2M_3(++)$: mutations are ascertained as mutated plants in a spike progeny in M_2 and also as segregating lines in M_3 family derived from normal M_2 plants of the progeny. $M_2M_3(+-)$: mutations are ascertained as mutated plants in a spike progeny only, and normal plant in the progeny give no segregating lines in M_3. $M_2M_3(-+)$: mutations are ascertained only as segregating lines in M_3 family. The probability of the occurrence of each case was calculated for various size of the mutated sectors. The expected proportion of the mutational events that are ascertained in M_2 to all the mutation ascertained is given in the equation (6). The proportion of the mutations which are not ascertained throughout M_2 and M_3 due to the occurrence of normal genotype in a mutated spikelet can be estimated from the equation (7). For a numerical example, experimental data for five treatments including two exposure stages and three exposure rate were presented and the mutation rate was estimated with correction of bias due to sector size by applying the present method. (auth)

26666 SOME OBSERVATIONS ON THE EFFECT OF CHRONIC GAMMA RADIATION ON YOUNG APPLE TREES. **Thakur, D. R.; Verma, Balak Ram (Regional Fruit Research Station, Mashobra, India). Sci. Cult. (Calcutta), 33: 76-7(Feb. 1967).**

Four varieties of apple trees were exposed to chronic gamma radiation for one year. Germination of vegetative buds occurred about four weeks later than the normal time. Flowers and fruits appeared on some trees during the first year; normally these do not appear until the fifth year. The fruits of the irradiated trees were small and seedless. Bifurcated shoots appeared in 3 plants, and a peculiar type of leaf appeared in one plant. The advantages of early fruit bearing are pointed out. (H.L.W.)

26667 DOSE-DEPENDENT CHANGES IN THE UREA PERMEABILITY IMMEDIATELY AFTER α IRRADIATION OF ALLIUM EPIDERMAL CELLS. I. STUDY OF THE DEPLASMOLYSIS BEHAVIOR IN TIME-PROTOPLAST LENGTH DIAGRAMS. Wattendorff, Joachim (Univ., Freiburg i. B.). Biol. Zentralbl., 85: 455-95(July-Aug. 1966). (In German).

The time-protoplast length diagrams showed that after doses of 1000 to 3000 Krad the permeability rose rapidly, and rapid deplasmolysis was ~ proportional to time and protoplast length. This was also seen in a nuclear protoplasts. After the lower doses of 60 to 100 Krad the permeability was reduced soon after irradiation. At doses between 100 and 1000 Krad the permeability came back to normal or became somewhat decreased soon after an initial increase. It was conjectured that 2 opposing factors affected permeability. If the protoplast remained semipermeable, then turgor would develop after deplasmolysis in urea. The slower the previous deplasmolysis was, the longer the time between complete deplasmolysis and development of turgor. Thus the turgor formation time was ~ the same length as the deplasmolysis time. The later loss of turgor indicated the loss of cell semipermeability and its final death. Except for the 3 greatest doses of 3360 to 3960 Krad there was no significant cell death even after many hr. This relative nonsensitivity could have been related to the addition of deplasmolytic to the treatment chamber during the irradiations, which would have diluted the secondary effects of irradiation due to chemicals formed. The amounts of irradiation used are compared with those reported in other studies. References cited, 49. (TCO)

26668 ACTIVATION OF THE INCORPORATION OF THYMIDINE-^{3}H INTO THE DEOXYRIBONUCLEIC ACID OF ARABIDOPSIS THALIANA L. HEYNH. INDUCED BY γ RAYS. Bonotto, S.; Jacobs, M.; Ledoux, L. (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). Arch. Int. Physiol. Biochim., 74: 311-12(Mar. 1966). (In French).

The seeds were irradiated in the dry state by increasing doses, up to 500,000 rad by a 3000-C ^{60}Co source. Thirty min after irradiation the seeds were incubated, in lots of 250, in Hoagland-Arnon medium containing thymidine-^{3}H, for 24 or 48 hr. The results showed that doses below 150,000 rad cause inactivation of the incorporation of thymidine into highly polymerized fractions of DNA. Doses of 200,000 to 500,000 rad inhibited this incorporation completely. Penetration of the DNA precursor is diminished as a function of the increasing dose. In seed irradiated shortly after initiation of germination, low doses (100,000 rad) immediately caused cessation of thymidine-^{3}H uptake. The activation of incorporation of the precursor into DNA in dry seeds irradiated at <150,000 rad, which has also been observed with the onion, may be the result of increased synthesis of DNA or other, unknown phenomena. (BBB)

26669 VARIABILITY OF BLACK CURRANT UNDER THE INFLUENCE OF IONIZING IRRADIATION. Melekhina, A. A. Latv. PSR Zinat. Akad. Vestis, No. 10, 83-91(1966). (In Russian).

Dormant black currant cuttings under the influence of irradiation with gamma rays 2000 to 5000 R and fast neutrons 300 to 1200 RAD were studied. With the increase of the irradiation dose, an inhibition of cutting terminal bud frondescence as well as lowered cutting rooting ability and oppression of plant growth were observed. A 5000 R dose of gamma rays and 1000 to 1200 RAD dose of fast neutrons are lethal for dormant black currant cuttings. Radiosusceptibility differs depending from the variety of black currant. Black currant cutting irradiation with gamma rays and fast neutrons in the tested dose range leads to a sharp increase in variability, and at that 0.7 to 6.7 per cent of all variation (according to the sort) overstep the limits of the black currant species. Fast neutrons, as compared to gamma rays, have a more pronounced effect on the variability of black currant. By irradiation with neutrons, 4.5 to 8.0 times more apparent morphological changes were obtained than by gamma-irradiation. New hybrid variety No. 127 and No. 1916 are characterized by more pronounced mutation ability under the influence of irradiation than the old Neaple variety. As normally developed offshoots tend to oppress the growth of altered offshoots, attention should be paid to a timely exposure, isolation, and propagation of the altered offshoots. (auth)

26670 EFFECT OF RADIOSTIMULATION OF WILD PASTURE GRASSES GROWING IN VARIOUS ECOLOGICAL CONDITIONS. Nazirov, N. N.; Gogenko, O. A. (Inst. of Experimental Plant Biology, Tashkent). Uz. Biol. Zh., No. 6, 3-7(1966). (In Russian).

Tabulated data on radiostimulation of seeds of wild growing grass and leguminous fodder exposed to ^{60}Co γ radiation of 25 R/sec prior to sowing, showed that the degree of radiostimulation of bioenergy varied for fodder growing in different ecological conditions. The effect of radiostimulation observed in the wild fodder was not retained in the seeds of the second generation. (R.V.J.)

26671 THE EFFECT OF SULFUR-CONTAINING ANALOGS OF SUGAR DERIVATIVES ON PLANT GROWTH AND METABOLISM. II. STUDY OF THE EFFECTS OF γ IRRADIATION ON THE GROWTH OF GERMINATING PEA PLANTS IN THE PRESENCE OF 1-THIO-D-GLUCOSE. Jiracek, Vladimir; Karlova, Marie; Kocourek, Jan (Karlova Univ., Prague). Rostlinna Vyroba, 37: 993-1000(1964). (In Czech).

The effect of γ radiation from ^{60}Co on the germination and growth of pea seeds in distilled water or in a 10^{-4} $\underline{M}$ solution of β-D-glucopyranosylmercaptan (1-thioglucose) was followed for 2 weeks at intervals of several days. It was shown that the germination of the seeds was not affected by even the highest radiation dose applied (500 R). The effect of the radiation on the root and stalk growth after 2 and 4 germination days was very low. The roots of the irradiated plants were only about 5% longer than in the non-irradiated control plants. Whereas on the 4th day the epicotyl of the control plants was still not developed, in the plants soaked in water and then irradiated, the epicotyl was developed. In germinating plants from dry irradiated seeds, irradiation doses of 750, 1000, and 5000 R also cause the development of the epicotyl. From the 8th day a strongly stimulating effect on the growth of roots and stalks of the pea germinating plants is observed. A favorable effect of thioglucose on the root and stalk growth of the germinating plants from seeds that were irradiated after soaking in a thioglucose solution is especially evident after low irradiation doses (250 and 500 R). On the 10th and 14th day the most favorable effects of the low doses (250 and 500 R) on the growth of the germinating plants from dry irradiated seeds were observed. The root length increases up to about 250%, but the stalk growth was less stimulated. The stimulating effect of the thioglucose is especially shown in plants from dry irradiated seed which are then germinated in a thioglucose solution. The effect is especially noticed on the root growth. The highest irradiation dose (5000 R) has a stimulating effect on the dry seed; in seeds that were irradiated in the wet state it has an inhibiting effect on the stalk growth and a weakly inhibiting effect of the root growth. The inhibiting effect of the irradiation cannot be eliminated with thioglucose. In conclusion it can be said that the stimulating effect of low radiation doses has an additive effect with the stimulation effect of thioglucose. The inhibiting effect of larger radiation doses cannot be compensated by thioglucose. (tr-auth)

26672 CHANGE IN THE RADIOSENSITIVITY OF BARLEY DURING MODIFICATION OF THE LIVING CONDITIONS. Nuzhdin, N. I.; Shangin-Berezovskii, G. N.; Pastushenko-Strelets, N. A. Tr. Inst. Genet., Akad. Nauk SSSR, No. 31, 55-79(1964). (In Russian).

The varieties Yubilein and Khar'kovski 306 were irradiated and grown in Moscow as controls. The Yubilein variety was less radiosensitive. With sowing under different ecological conditions, that is, in different districts of Russia, different radiosensitivities were found, so that Yubilein could become the more radiosensitive variety. It is concluded that these changes are not directly connected with the damaging effects of uncommon conditions. (tr-auth)

26673 EFFECT OF THE GAMMA IRRADIATION OF WHEAT SEEDS ON THE RADIOSENSITIVITY OF DESCENDANTS OF THE TEST PLANTS. Fonshtein, L. M. Tr. Inst. Genet., Akad. Nauk SSSR, No. 31, 246-54(1964). (In Russian).

Irradiation of Moscow variety wheat seeds in the M_1 with doses of 4 and 8 kR, resulted in an increase of the resistance of the descendants of the test plants to repeated doses of ionizing radiation in the M_2 at doses of 12 and 16 kR. In the Lyutestsens 62 variety, a distinct protective effect was observed only with irradiation of the seeds in the M_1 at 8 kR. Transplantation of buds of non-irradiated seeds of the Moscow and Lyutestsens 62 varieties on the endosperm of seeds irradiated at 12 and 500 kR do not produce real changes in the reactions of descendants of test plants to repeated irradiation at doses of 12 kR. In irradiated seeds of the Moscow variety in the M_1 at doses of 16 kR, an increase of radiation damage was observed in repeated irradiation of the test plants in M_2 at 12 and 16 kR in comparison with single irradiation of the seeds at the same dose (measured on the survival of the plants and the number of cells with chromosome aberrations). (C.O.)

26674 ACCUMULATION OF TOBACCO MOSAIC VIRUS IN X-IRRADIATED PLANT TISSUES. Pod'yapol'skaya, T. S. Tr. Inst. Genet., Akad. Nauk SSSR, No. 31, 359-69(1964). (In Russian).

The decrease of the titer of tobacco mosaic virus after irradiation of tobacco leaves was not connected with the inactivation of the virus in the cells or the increase of the inhibiting virus of the sap from the irradiated leaves. It reflects the decrease in quantity of virus nucleoproteids formed in the leaves. The irradiation of leaves of tobacco at doses from 0.5 to 100 kR leads to a decrease in their tobacco mosaic virus titer: the higher the irradiation dose the greater the decrease of the titer. However the dependence of the tobacco mosaic virus titer on the irradiation dose was very clearly shown at comparatively low irradiation doses. The irradiation of tobacco leaves at 25 and 50 R leads to a small increase of the virus titer. The number of centers of infection (necroses) on leaves of N. glutinosa does not change during irradiation at doses at 25 kR and decreases at very high irradiation doses. The reduced capacity for accumulation of the virus in tobacco leaves irradiated at 15 kR, is not recovered for three days after irradiation and in leaves irradiated at 50 and 100 R there is no recovery for 5 to 7 days. The decrease of the virus titer in tobacco leaves infected after irradiation at 25 kR is explained by no inactivation of the infection centers and by the decrease of the velocity of accumulation of the virus in the early stage of the infection process. During the accumulation of the virus in the irradiated (15 kR) isolated leaves or plants, the changed forms of the virus were not eliminated. The infectivity in units of nucleic acid in virus preparations prepared from irradiated and non-irradiated leaves is similar. (tr-auth)

26675 COMPARATIVE STUDIES OF X- AND γ-RAY EFFECTS ON DRY SEEDS OF WHEAT LUTESCENS-62. Novozhilova, N. P. Tr. Inst. Genet., Akad. Nauk SSSR, No. 31, 405-8(1964). (In Russian).

A comparative study is made of the effects of x and γ radiation on the intracellular changes in Lutescens-62 wheat. The data show that with increase of the dose the percentage of cells with aberrations increase which was observed with both types of irradiation. The x radiation caused a higher percentage of cells with aberrations than γ radiation. The isoelectric point of nuclei and protoplasm of irradiated and control plants was also investigated. The pH of the isoelectric point of nuclei and cytoplasm of the active parts of roots is displaced to the alkaline side, indicating a decrease of the rate of cell activity. (J.S.R.)

26676 BIOLOGICAL PROPERTIES OF THE (X_5 AND X_6) DESCENDANTS OF PLANTS CULTIVATED FROM X-IRRADIATED OAT PLANTS. Zakharova, G. M. Tr. Inst. Genet., Akad. Nauk SSSR, No. 31, 409-13(1964). (In Russian).

The biological properties of the X_5 and X_6 descendants of irradiated oat plants of the Dippe and Pobeda variety were investigated. In the Dippe variety in the X_5 generation, 0.79% plants with the characteristics of wild oats appeared and in the Pobeda variety 33.4% had wild oat characteristics. In Dippe variety, dying out occurred and in the Pobeda variety, an intensification of the form evolution processes occurs. Differences in the form evolution processes observed in the two varieties can be explained by the fact that the dry seeds of Dippe variety were exposed to 8000 R and the Pobeda variety to 13000 R. The degree of viability decrease in plants of both varieties under the doses indicated was similar. Single doses of 13000 R caused much greater disturbances in the physiological arrangement of the organism than 8000 R. (tr-auth)

26677 GENETIC VARIATION IN OIL AND PROTEIN CONTENT OF SOYBEANS INDUCED BY SEED IRRADIATION. Williams, J. H.; Hanway, D. G. (Univ. of Nebraska, Lincoln). Crop Sci., 1: 34-6(Jan. 1961).

Irradiation of seeds of Adams and Hawkeye soybean varieties with x rays and thermal neutrons increased significantly the genetic variability for several quantitatively inherited characters. Estimates of genetic variance for yield, plant height, maturity, and seed weight averaged 5 times as large in the populations derived from seed treated with x rays and thermal neutrons as in the controls. Gains expected from selection for all characters studied except plant height were also much higher in irradiation treatment groups. Results of analyses of data on content of oil and protein obtained from the same populations are described. The effects of radiation on the mean performance of the two varieties were different for both oil and protein. In the Adams variety the control population had the highest mean oil and protein content, each significantly higher than that for the radiation treatment groups. Differences between the x-ray and neutron treatment means were not significant for either oil or protein percentage in Adams. In Hawkeye, the mean oil percentage of the control was intermediate to the x-ray and neutron treatment means, which were significantly different from one another but neither significantly different from the control. The mean protein content of the control was lower than either of the irradiated varieties and significantly lower than the Hawkeye irradiated population. The range of progeny means for oil and protein was greater in both varieties when seed was exposed to radiation. Sterility was a factor in increasing the genetic variance in the groups that were irradiated. (BBB)

26678 PROCEEDINGS OF THE AGRICULTURAL SYMPOSIUM, MAY 13–14, 1966. Dacca, Pakistan, Atomic Energy Center, 1966. 187p. (CONF-660564).

Separate abstracts were prepared for 11 of the 26 papers included. Papers not abstracted deal with various aspects of plant genetics, plant physiology, nutrition, entomology, and plant pathology. (H.L.W.)

For abstracts of individual papers see: 26368–26370, 26636–26638, and 26679–26683.

26679 STUDIES ON INDUCED MUTATIONS IN RICE. Miah, Abdul Jalil; Bhatti, I. M.; Ghafoor, A. (Atomic Energy Agricultural Research Center, Tandojam, Pakistan). pp 1-6 of Proceedings of the Agricultural Symposium. Dacca, Pakistan, Atomic Energy Center, 1966.

Seeds of two rice varieties, namely Kangni-27 and Dokri Basmati, were irradiated with different doses of gamma rays from a ^{60}Co source. In the X_1 generation germination percentage, seedling height and seed fertility were examined. The data indicated that Kangni-27 is more radioresistant than Dokri Basmati. In the X_2 generation, two polygenic traits were studied. From the analysis of the data, it was found that variability was greater in the irradiated populations than in the non-irradiated controls. Apart from the study of the polygenic traits several mutants, which appeared to be useful from the breeders point of view, were isolated from the irradiated populations of Kangni-27. (auth)

26680 STUDIES ON THE EFFECT OF GAMMA RADIATION ON CASTOR BEANS (RICINUS COMMUNIS L.). Baluch, Manzoor Ahmad A.; Natali, A. H.; Bukhari, Mazhar Ali Shah (Atomic Energy Agricultural Research Center, Tandojam, Pakistan). pp 7-14 of Proceedings of the Agricultural Symposium. Dacca, Pakistan, Atomic Energy Center, 1966.

The seed lots of Castor variety C-22 were subjected to 20, 30, 40, 50, 60, 70, 80, and 90 KR doses of gamma radiation from a Co-60 source. The irradiated material was sown in X^1 generation during the year 1965–66. Field and laboratory observations on germination percentage, plant height upto first spike, number of internodes upto first spike, percentage of pistillate flowers, number of spikes per plant, seed index (weight of 200 seeds), spiny versus smooth capsules and green versus red pigmented plants, were recorded in X^1 generation. It was observed that as the dose of radiation is enhanced beyond 30 KR, number of spikes, number of capsules and seed yield per plant declines. No differences were, however, observed in morphological characters like number of internodes, seed index and proportion of male and female flowers in X^1 generation. (TSS)

26681 GAMMA RADIATION AND INTERSPECIFIC HYBRIDIZATION IN JUTE (CORCHORUS CAPSULARIS L. AND C. OLITORIUS L.). Mia, M. M.; Shaikh, A. Q. (Atomic Energy Center, Dacca, Pakistan). pp 20-5 of Proceedings of the Agricultural Symposium. Dacca, Pakistan, Atomic Energy Center, 1966.

Although numerous attempts have been made during the last five decades, no hybrids combining the qualities of the two commercially most important species have been released so far. Dry seeds of Corchorus capsularis L. var. D-154 and Corchorus olitorius L. var. C. G. were irradiated with gamma rays of various intensities from 70 to 100 KR. and were sown in the field. Abnormal plants of the first generation showing bilobed and crinkled characters in their leaves induced by gamma rays were chosen as male parents. Three hundred crosses of different combinations were made. In all 120 fruits developed into maturity. All the seeds failed to germinate except from the crosses ♀ C. G. (0 KR.) × ♂ D-154 (80 KR.) and ♀ D-154 (0 KR.) × ♂ C. G. (70 KR). F_1 plants from the cross ♀ C. G. (0 KR.) × ♂ D-154 (80 KR.) inherited the bilobed character of the male parent whereas the plants from the other cross failed to show any sign of inheritance of the male parent. This indicated that the plants from the cross ♀ C. G. (0 KR.) × ♂ D-154 (80 KR.) were hybrids. These hybrids attained a greater height than the controls and were highly fertile. (auth)

26682 STUDY ON THE TIME OF SELECTION IN THE SUCCESSIVE MUTANT GENERATIONS OBTAINED BY IRRADIATING SEEDS OF THREE RICE VARIETIES. Hasanuzzaman, S. M. (Agriculture Research Inst., Dacca, Pakistan). pp 26-33 of Proceedings of the Agricultural Symposium. Dacca, Pakistan, Atomic Energy Center, 1966.

Seeds of three varieties of rice, Patnai-23, Latisail, and Nizersail were irradiated with two dosages of x rays and thermal neutrons. A thorough selection was carried out both at seedling and mature plant stages of M_1. Replicated yield trials with selected normal looking healthy plants of the mutant and parental stocks were carried out for three successive years. Selected mutants were grown and reselected on an individual plant basis. All undesirable mutants were eliminated and finally the desirable types were tested along with the parental varieties. The result showed that highly significant variations existed in M_1 whereas the difference in variations became reduced to the level of insignificance at the succeeding generations, M_2 and M_3, thus showing that heavy screening at M_1 was very effective and there was very little practical value for selection in either M_2 or the following M_3 generations. (auth)

26683 EVOLUTION OF NEW VARIETIES OF MANGO (MANGIFERA INDICA, L.) THROUGH INDUCED SOMATIC MUTATIONS BY IONIZING RADIATION. Siddiqui, S. H.; Mujeeb, K. A.; Vasti, S. M. (Atomic Energy Agricultural Research Center, Tandojam, Pakistan). pp 34-7 of Proceedings of the Agricultural Symposium. Dacca, Pakistan, Atomic Energy Center, 1966.

Mango (Mangifera indica, L. Var. Dashehari) bud wood was subjected to acute radiation doses of 1,000, 2,000, 3,000, 4,000, 5,000 R, and budded on the parent trees. A promising shoot from the 3,000 R dose has exhibited morphological changes pertaining to leaf size, branch agglomerations, delayed floral bud initiation and anthesis. These induced changes may be due to the chimaeral expressions of the irradiated bud and may prove beneficial in extending the fruiting season. (auth)

Radiation Effects on Microorganisms

Refer also to abstracts 26330, 26358, 26377, 26485, 26504, 26559, and 26711.

26684 (ORNL-TM-1734) NEUROSPORA EXPERIMENT P-1037. Progress Report to the National Aeronautics and Space Administration Covering the Period from Initiation Through September 30, 1966. (Oak Ridge National Lab., Tenn.). Mar. 1967. Contract W-7405-eng-26. 102p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

FUNGI—radioinduced mutations of Neurospora, effects of vibration and zero gravity on γ and x
MUTATIONS—radioinduced in Neurospora, effects of vibration and zero gravity on γ and x
GRAVITATION—absence of, effects on mutation radioinduction in Neurospora exposed to
VIBRATIONS—effects on mutation radioinduction in Neurospora
GAMMA RADIATION—effects on genetics of Neurospora, effects of vibration and zero gravity on
X RADIATION—effects on genetics of Neurospora, effects of vibration and zero gravity on
SPACE FLIGHT—effects of conditions of, on radioinduced mutations of Neurospora
PACKAGING—design for biological materials during space flights
RADIATION DOSIMETERS, THERMOLUMINESCENT—performance for γ measurements
ANOXIA—effects on radiosensitivity of Neurospora, γ and x
(C.H.)

26685 (TID-23707) THE EFFECT OF REPEATED TREATMENT WITH GAMMA RAYS ON THE RADIO-RESISTANCE, VIRULENCE AND CULTURE CHARACTERISTICS OF CERTAIN PATHOGENIC AND RELATED BACTERIA. Licciardello, J. J.; Nickerson, J. T. R.; Goldblith, S. A. (Massachusetts Inst. of Tech., Cambridge. Dept. of Nutrition and Food Science). Feb. 1967. Contract AT(30-1)-3325. 57p. Dep. CFSTI.

A number of parameters which might influence radio-resistance of salmonella were investigated in order to adopt a uniform procedure for culturing, irradiating and recovering organisms whose radio-resistance was to be determined. There was not much difference in radio-resistance among 14- and 24-hour cultures, but 32- and 48-hour cultures were more radio-resistant. Oxygenation prior to irradiation decreased the decimal reduction dose by a factor of about three to four. Cultures grown at 37°C were more radio-resistant than cultures grown at 30°C or 20°C. The radio-resistance of Salmonella newport, S. thompson and S. heidelberg was approximately the same whereas S. typhimurium was notably more radio-resistant. With regard to effect of temperature during irradiation, S. typhimurium was least resistant when irradiated at 43.3°C, more resistant at 0°C and most resistant at –17.6°C. Following high irradiation doses (about 10^{-6}% survival) a greater recovery of survivors generally resulted when petri plates were incubated at 37°C as compared to 20°C. Experiments to determine the effect of aerobic or anaerobic growth on radio-resistance did not yield consistent results with different salmonella serotypes. Salmonella grown at 37°C while exposed to a low flux of gamma radiation did not have an increased radiation resistance. A marked increase in radio-resistance occurred with cultures of S. newport which had been subjected to five irradiation cycles. With S. typhimurium a slight increase in radio-resistance was observed. Radio-resistant mutants of S. newport have been isolated by the double-irradiation plate method. (auth)

26686 BACTERIOSTATIC EFFECT OF ^{60}Co γ-RAY IRRADIATION ON OYSTER. Sasaki, Satoshi (Lab. of Public Health, Hiroshima Prefecture, Japan); Kajiwara, Nobuyuki. Hiroshima-ken Eisei Kenkyushoho, No. 13, 22-7(Mar. 1963). (In Japanese).

The bacteriostatic effect of ^{60}Co γ irradiation on oysters was experimentally studied. Suspensions of 8 kinds of bacteria were isolated from shucked oysters, including 3 Gram-negative bacilli, 2 Gram-positive bacilli, 1 Enterococcus, 1 Streptococcus viridans and 1 Staphylococcus, in a physiological sodium chloride solution and were irradiated by ^{60}Co γ-rays. A dose of 7×10^4 R (60 minute irradiation) reduced the number of living germs to 0.003 to 0.0001% of that before irradiation. When the same 8 species were irradiated in an oyster emulsion, the reduction in the numbers of living germs was slight; the numbers were reduced to 9, 0.3, 0.03 and 0.01% of those before irradiation in the 60, 120, 300, and 600 minute irradiations, respectively. To produce the same effects as in the case of suspensions in physiological sodium chloride solution, five times as large a dose was required. Oysters were irradiated with a dose of 3.5×10^5 R (300 minute irradiation), and the bacteriostatic effect was examined. The number of living germs was reduced to 0.02%. (NSA of Japan)

26687 PREVENTION OF PHOTOREACTIVATION OF TOBACCO MOSAIC VIRUS: RIBONUCLEIC ACID BY RECONSTITUTION. **Small, Gary D.; Gordon, Milton P. (Univ. of Washington, Seattle). Photochem. Photobiol., 6: 303-8(May 1967).**

Data are presented to show that reconstitution of tobacco mosaic virus (TMV) from viral protein and uv-irradiated RNA prevents photoreactivation of TMV-RNA. The photoreactivation of TMV-RNA irradiated with either 253-7 mμ or 302 mμ uv light was attempted. The prevention of photoreactivation by reconstitution was not irreversible as the RNA could be extracted from the reconstituted virus and was still capable of undergoing photoreactivation. Whether the RNA molecules that are potentially photoreactivable are selectively excluded from reconstitution or the potentially photoreactivable damage is destroyed by the conditions of reconstitution was considered. The fact that photoreactivable RNA can be recovered by phenol extraction of the reconstituted virus proves that this is not the case. A possible explanation for the prevention of photoreactivation by reconstitution is that the viral protein binds to the uv-irradiated RNA in such a manner that the protein cannot be removed by the normal mechanism. A second possible explanation is that the light-dependent repair enzyme or enzymes occur in the cytoplasm of the cell whereas the uncoating and replication of the virus occurs in the nucleus. (BBB)

26688 SOME OBSERVATIONS ON THE RADIOSENSITIVITY OF HAPLOID AND DIPLOID STRAINS OF SCHIZOSACCHAROMYCES POMBE TO X-RAYS. **Rao, K. R. (Univ., Zurich). Radiol. Clin. Biol., 35: 300-4(1966).**

Dose-effect studies based on survival rates of haploid and diploid strains of *Schizosaccharomyces pombe* to x rays were conducted and no appreciable difference was observed between the radiosensitivities of the said strains. It is inferred that the diploid strain of any yeast culture need not always be more radioresistant than the haploid strain of the same organism as is generally believed. (auth)

26689 EFFECT OF RADIOPHOSPHORUS DECAY ON CISTRON FUNCTION IN BACTERIOPHAGE T4. II. STABILIZATION TO INACTIVATION DURING PHAGE GROWTH. Harriman, Philip D. (Institut du Radium, Paris); Stent, Gunther S. J. Mol. Biol., 17: 407-17(June 1966).

The lethal effects of β particles emitted on decay of incorporated ^{32}P on the functional and genetic survival of various early and late cistrons of bacteriophage T4 were examined at successive stages of intracellular phage growth. Host bacteria nonpermissive for am mutants were infected jointly with ^{32}P-labeled am$^+$ wild type and nonradioactive am mutant phages. These experiments showed that during the first few minutes of phage growth a progressive reduction occurred in the ^{32}P decay sensitivity, or stabilization, of functional and genetic survival of early and late viral cistrons. Decay stabilization of cistron function depended on protein synthesis in the cell, since it did not proceed in the presence of chloramphenicol. Interference with protein synthesis by amino acid downshift of the host bacteria just prior to infection also greatly retarded the stabilization of phage infectivity, stabilization of genetic survival of early and late cistrons, and stabilization of function of late cistrons, but it did not seriously delay stabilization of function of early cistrons. It was concluded that the progressive stabilization to ^{32}P decay inactivation which occurred at early stages of intracellular T4 phage growth was not derived from replication or from phenotypic expression of the infecting phage genome. Instead, it represented a progressive reduction in the intrinsic radiosensitivity of the viral DNA, that is, by a gradual radioinduced change in structure. (TSS)

26690 ACRIDINE ORANGE-SENSITIZED PHOTOINACTIVATION OF T4 BACTERIOPHAGE. II. GENETIC STUDIES WITH PHOTOINACTIVATED PHAGE. Cramer, W. A. (Univ. of California, La Jolla); Uretz, R. B. Virology, 29: 469-79(July 1966).

The extent of multiplicity reactivation was much smaller in T4o$_1$ phage inactivated by visible light ($\lambda > 410$ mμ) in the presence of the dye acridine orange than in uv-inactivated phage. The rII$^+$ and am$^+$ markers of such dye-light treated phage could be cross reactivated with an efficiency that was appreciable, though less than for uv. The rII$^+$ A and B cistrons were also more sensitive to inactivation by dye-light than to uv. The adsorption to sensitive host cells of a ^{32}P-labeled phage population was not affected by more than 100 phage lethal hits of dye-light. The bacterial host-killing ability was inactivated at about the same initial rate by dye-light as by uv. It was concluded that there were at least two components of the acridine orange visible light damage in phage T4o$_1$: localized genetic damage and another probably equivalent to injection damage. (BBB)

26691 THE RADIATION SENSITIVITY OF ESCHERICHIA COLI B: A HYPOTHESIS RELATING FILAMENT FORMATION AND PROPHAGE INDUCTION. **Witkin, Evelyn M. (State Univ. of New York, Brooklyn). Proc. Nat. Acad. Sci. U. S., 57: 1275-9(May 1967).**

An explanation of uv-sensitivity and filament formation in *E. coli* strain B is offered. It is suggested that strain B contains a repressor that, like the repressor of λ phage, is inactivated by a complex process that starts with the presence of replication-blocking lesions, such as pyrimidine dimers, in the DNA. The repressor is inactivated by uv only if protein synthesis occurs before the repair of pyrimidine dimers in DNA. Inactivation of repressor B induces an operon that may be part of an integrated episome or part of the bacterial genome proper. A product of operon B (presumably a protein) is an inhibitor of cell division or can lead indirectly to the production of such an inhibitor. Ultraviolet-induced repression of operon B is restored when the repair of pyrimidine dimers in DNA is completed. Therefore, filamentous growth results from induction of operon B and synthesis of a sufficient quantity of the inhibitory product of operon B to cause persistent inhibition of mitosis, even after accomplishment of DNA repair. Recovery of the ability to divide depends on accumulation of the inhibitor in the cell while operon B is in the derepressed state. If the filament has elongated to a critical length, recovery is impossible. (H.G.D.)

26692 STUDIES ON INDUCED MUTANTS OF PIRICULARIA ORYZAE AND ON THEIR PATHOGENICITY. **Kuo, Tsong-teh; Yang, Lie-hsueh; Yeh, Pao-zun; Li, H. W. Bot. Bull. Acad. Sinica (Taiwan), 8: 20-9PJan. 1967).**

Biochemical mutants were induced in a line of *Piricularia oryzae* by treatment with various kinds of mutagens. Several mutants were obtained from the survivors of ultraviolet irradiated parents by a modified total-isolation technique. Among the mutagenic agents tested, N-methyl-N′-nitro-N-nitrosoquanidine seemed to give the best results. Sixteen nutritional exacting mutants that required methionine, lysine, histidine, arginine, asparagine, glutamic acid, leucine, isoleucine or xanthosine were obtained. Some of the mutants were morphologically distinct from their parent; others lost the ability to sporulate. Pathogenicity tests on 13 different hosts revealed that the pathogenicity of the mutants thus obtained was reduced. (B.H.S.)

26693 INFLUENCE OF HIGH FREQUENCY AND GAMMA IRRADIATION ON THE MICROFLORA AND THE SOIL ENZYMES. **Voets, J. P.; Dedeken, M. (Rijkslandbouwhogeschool, Ghent). Meded. Landbouwhogesch. Opzoekingssta. Staat Gent, 30: 2037-49(1965). (In Dutch).**

Effects of high frequency and γ irradiation on the microflora and enzymatic activity of air-dried soil were studied. Microwave (40 or 90 Mcps) treatment (even at 100°C for 60 sec) did not result in a complete sterilization of the soil. The number of microorganisms diminished under the influence of the temperature used. Soil enzymes were also altered in activity. An appreciable decrease in the activity of saccharase and proteolytic enzymes was observed with high frequency irradiation of soil. Ionizing irradiation (^{60}Co, 2 Mrad) completely sterilized air-dried soil, but the enzymatic activities remained unchanged. Comparative tests (saccharase, urease, acid phosphatase, and proteolytic activity) on an air-dried soil treated with toluene and on the same soil treated with an electron beam showed that the enzymatic activity was nearly the same in the 2 samples. Toluene treatment of air-dried soil gave reproducible results. (BBB)

26694 ON THE INFLUENCE OF UV RADIATION ON THE SURVIVAL RATE OF SPORES OF VARIOUS SPECIES OF ASPERGILLUS. **Olejniczak, Olga Ilnicka (Inst. for Industrial Fermentation, Warsaw); Sozynski, Jerzy. Mycopathol. Mycol. Appl., 30: 129-36(Nov. 10, 1966). (In German).**

Air-dried spores of the following Asperigillus species were irradiated with 254-mμ (uv) radiation at dose rates of 190 or 220 erg/mm^2/sec for irradiation times of 1, 3, or 5 hr: *A. flavus*, *A. flavescens*, *A. herbariorum*, *A. luchuensis*, *A. niger*, *A. ochraceus*, *A. oryzae*, *A. tamarii*, *A. terreus*, and *A. wentii*. These doses were designed to give survival rates of roughly 50, 20, and 1%. The radiosensitivity of the different species of spores was found to vary greatly, or as much as 150 fold. For example, a dose of 3960×10^3 erg/mm^2 gave a survival rate of only 0.04% for *A. oryzae* compared with 5.6% for *A. niger*. There was some correlation between the mass of the individual spores and survival rate, the larger the spore the greater the number of survivors. Probably the fact that cell wall is single or double affected the uv sensitivity of Aspergillus spores. (BBB)

26695 QUANTITATIVE STUDY OF RAUSCHER VIRUS INACTIVATION BY VARIOUS PHYSICAL AND CHEMICAL AGENTS. Levy, J. P.; Oppenheim, S.; Chenaille, Ph.; Silvestre, D.; Tavitian, A.; Boiron, M. (Hopital St. Louis, Paris). J. Nat. Cancer Inst., 38: 553-65(Apr. 1967).

The inactivation curves of Rauscher murine leukemia virus (RV) submitted to various physicochemical agents have been studied with repeated titrations. The agents involved were: temperature, pH, molarity, ionic composition of the medium, mechanical factors, ultraviolet light, trypsin, and formalin. They were classified into three groups: factors rapidly inactivating RV :56 C, ultraviolet light, mechanical agitation, pH 3, 0.50% trypsin, and $^{1}/_{400}$ formalin; agents inactivating RV with a lower rate: 37°C, 20°C, high molarity, NaCl 0.14 M, pH 4 and 5, formalin $^{1}/_{1000}$ or $^{1}/_{4000}$, factors inducing no or little inactivation: 4 C, −170°C, low molarity, pH 9.3. (auth)

26696 FUNCTION OF CAROTENOIDS IN PROTECTION OF RHODOTORULA GLUTINIS AGAINST IRRADIATION FROM A GAS LASER. Maxwell, W. Andrew; Macmillan, James D.; Chichester, C. O. (Univ. of California, Davis). Photochem. Photobiol., 5: 567-77(July 1966).

The sensitivity of older cells of R. glutinis containing a high concentration of carotenoids was compared with young cells containing little visible pigmentation. The younger cells died faster, suggesting that the carotenoids protected. Further, cells grown in the presence of diphenylamine, an inhibitor of carotenoid synthesis, were more susceptible than normally grown cells. A carotenoidless mutant, isolated after exposure of the wild strain to uv light, was more susceptible to lethal photosensitization than the wild strain. The difference in sensitivity, however, was not as great as between old and young cultures of the wild strain. Young cultures of the white mutant were more susceptible to death than were older cultures; therefore, sensitivity is related to age as well as to carotenoid content. The difference in sensitivity was increased between the white mutant and the wild strain when lower light intensities were used. At 10 mw the difference in the lag period was 60 min, while at 30 mw the difference was only 10 min. The lag period was also dependent on the temperature at which cell suspensions were irradiated. At 3°C, no death occurred in 1 hr at 27 mw with either wild or mutant strains. The lag was progressively shorter with increased temperature. The rate of death, however, was apparently not affected by differences in temperature. An analysis of the carotenoids from the irradiated cells did not show any detectable changes even though it was demonstrated that β-carotene could be bleached when irradiated in vitro in the presence of toluidine blue. (BBB)

26697 EFFECT OF EXTERNAL IONIZING RADIATION (BETATRON X RAYS) ON THE BIOLOGICAL ACTIVITY OF PENICILLIN (REPORT NO. I). Iakim, S. M. Vrach. Delo., 7: 76-3(July 1965). (In Russian).

The influence of betatron irradiation (12.5 and 25 MeV) on the biological activity of commercial potassium and sodium salts of penicillin in a sterile powder form was studied. Preparations were irradiated at room temperature in glass bottles, covered with rubber stoppers and aluminum caps and at a distance of 25 cm from the source of radiation, at doses of 100, 250, 500, 1000, 10,000, and 100,000 R at 12.5 MeV; and 100, 250, 500, 1000, 10,000, 100,000, 600,000, and 1,500,000 R at the maximum betatron energy of 25 MeV. The activity of irradiated and control penicillin preparations was determined by the microbiological method with Staphylococcus aureus 209-R as the test organism at 24 hr, and 1, 6, and 12 months after irradiation. Completely different results were obtained for activity of penicillin irradiated at the two energies, showing that the energy of the radiation is important. Loss of activity of the antibiotic was also related to the dose. Irradiation with the different doses at the lower energy (12.5 MeV) did not lead to substantial changes of penicillin activity, whereas irradiation at high energy (25 MeV) resulted in complete loss of specific antimicrobial activity of the preparation. (BBB)

26698 REJOINING OF X-RAY INDUCED BREAKS IN THE DNA OF LEUKEMIA CELLS. Lett, J. T.; Caldwell, I.; Dean, C. J.; Alexander, P. (Royal Cancer Hospital, London). Nature, 214: 790-2(May 20, 1967).

The number of breaks produced by x rays in the polynucleotide chains of the DNA in murine leukaemia cells, in the bacterium Micrococcus radiodurans, and in isolated DNA were approximately the same. The leukaemia cells have an efficient system for rejoining broken strands. The results also suggest that the molecular weight of the mammalian DNA is very high. (auth)

26699 ULTRAVIOLET SENSITIVITY AND FUNCTIONAL CAPACITY IN BACTERIOPHAGE T4. Ebisuzaki, K. (Massachusetts General Hospital, Boston). J. Mol. Biol., 20: 545-58 (Oct. 1966).

Some gene functions that characterize different phases of the phage development were studied after uv irradiation of the wild-type phage. T4V$^+$, and its uv-sensitive derivative, T4V. The so-called early gene functions were equally sensitive in both strains. However, the intermediate function thymidylate synthetase, and the late functions were much more sensitive in T4V as compared to T4V$^+$. Ultraviolet irradiation of the phages at different wavelengths indicated that the V gene function is related to a specific chromophore. The observation that inactivation of this chromophore was paralleled by the loss of certain gene functions is discussed in the context of the regulation of the multigenic systems of the phage. (BBB)

26700 INTENSITY OF POSTRADIATIONAL REGENERATION OF YEAST CELLS ON VARIOUS MEDIA IN THE PERIOD PRECEDING DEVELOPMENT OF RADIATIONAL DAMAGE TO THE MULTIPLICATION PROCESS. Malinovskii, O. V.; Mityushova, N. M. (Pavlova Inst. of Physiology, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 170: 455-6(Sept. 11, 1966). (In Russian).

Saccharomyces cerevisiae cultures that were irradiated to 60 krads with ^{60}Co γ radiation at a rate of 800 rads/min were held 4 hr at 30°C in a nutrient medium and then tested for viability. Their viability was the same as that of cells similarly irradiated and held in a less-concentrated nutrient medium or in water. Recovery was no different under aerobic and anaerobic conditions in the presence of a substrate (glucose) for their enzyme. In the absence of glucose, under anaerobic conditions recovery did not take place. These results were considered to be due to a dissimulation of the carbohydrate reserves of the yeast in the anaerobic cultures. The experimental results were interpreted as showing that prior to cell division there was no difference between recovery on a nonnutrient medium, where the cell was in the stationary phase, and on a nutrient medium where preparation for cell division is taking place. (TTT)

26701 PHOTOPROTECTION AGAINST X-RAY DAMAGE IN STAPHYLOCOCCUS AUREUS. Savage, Norman Lee. Norman, Okla., Univ. of Oklahoma, 1966. 86p.

Thesis.

Photoprotection against x-ray effects causing cell death and genetic damage has been reported. Although not yet shown to be as universal as photoreactivation of ultraviolet damage, photoprotection against lethal x-ray effects has been found in several microorganisms. A complete evaluation of the significance of photoprotection against x-ray damage has been hampered by variability of results and small amounts of protection. A more complete characterization of the phenomenon would be beneficial in determining its significance. The initial phase of the investigation was a characterization of the effect in relation to cell age and altered growth conditions. It was found that maximum photoprotection in Staphylococcus aureus resulted from cells in the log phase of growth. This was found for cells grown on nutrient or brain heart infusion medium. Growth on brain heart infusion resulted in higher x-ray resistance but no actual increase in photoprotection. No photoprotection was found in cells incubated at a reduced temperature (29°C) in contrast to those incubated at 37°C. Anaerobic growth was found to have no effect on photoprotection, but anoxic x-irradiation completely nullified the protective effect. This organism was found to be sensitive to the visible light used for photoprotection. Selection of x-ray resistant cells by the light was implicated by a correlation of increased visible light killing and increased photoprotection during the growth cycle. However, studies on cells grown under continuous illumination, selected by successive visible light treatments, and selected by successive x-ray exposures eliminated selection as a factor. Studies on the rate of growth of the organism after visible and x-irradiation, singly and in combination, showed a light-induced growth delay. It was proposed that this delay would allow more time for cell recovery from x-ray damage and thus account for the protective effect of light. Supportive evidence was obtained by correlating visible light growth rate effects with previous observations on the protective phenomenon. Correlations were made with the effects of x-ray dose rate, visible light dose rate, incubation temperature, and cell age. Results of experiments presented are discussed on the basis of increased or impaired recovery. (Dissertation Abstr.)

Radiosterilization and Radiopreservation

Refer also to abstract 26354.

26702 (STI-PUB-127) FOOD IRRADIATION. Proceedings Series. Proceedings of the International Symposium held in

Karlsruhe, 6–10 June 1966. (International Atomic Energy Agency, Vienna (Austria)). Nov. 1966. 960p. (CONF-660609). IAEA: \$20.00; S 517,-; £ 7.1.2; F Fr 98,-; DM 80,-.

Separate abstracts were prepared on 40 papers. Abstracts were prepared previously on 28 papers and appeared in NSA as Conf-660609 or Conf-660610. (C.H.)

For abstracts of individual papers see: 26259 and 26707–26745.

26703 EXPERIMENTAL STUDY ON ^{60}Co IRRADIATED BONE FOR TRANSPLANTATION. Ota, Masanori (Kyushu Univ., Fukuoka). Igaku Kenkyu, 33: 253-68(Oct. 1963). (In Japanese).

Irradiation for the sterilization of bone to be transplanted was found to be very effective. *Staphylococcus aureus*, strain 209, was completely eliminated by doses of 75×10^4 R of irradiation and *Bacillus subtilis* by 180×10^4 R. The ^{60}Co irradiated bone (200×10^4-R doses) which was transplanted in the radial shaft as pieces 2.5 to $3.0 \times 1 \times 0.5$ cm in size was compared roentgenologically, immunologically, histologically, and angiographically with control samples, i.e., fresh autografts, frozen bone (–17°C), and frozen dry bone. The results with the irradiated bone were similar to those with the frozen bone, but there was delay of union in comparison with the fresh autografts, although healing in the same way occurred. It is concluded that ^{60}Co irradiated bone is suitable for transplantation. The irradiated bone is readily stored for long periods at room temperature and can be transported easily, making it ideally suited for bone bank use. (BBB)

26704 TOWARDS BETTER INSECT CONTROL. Nelson, Stuart O. (Dept. of Agriculture, Lincoln, Neb.). Crops Soils, 18: No. 1, 8-9(1965).

Use of ionizing and nonionizing radiations to control insect pests is reviewed. Successful application of the sterile-male technique to eradicate some species, such as the screwworm and the melon fly are described. In the sterile insect release method, it is necessary to rear large numbers of the insects, sterilize them by exposure to ionizing radiation, and release them to mate with the natural population to reduce and eventually eliminate the population. Direct irradiation of the population also appears to have a good potential for controlling certain stored-product insects. Doses of radiation that kill insects do not damage wheat for milling and baking or affect nutritional qualities to any noticeable degree. The U. S. Food and Drug Administration has approved wheat irradiation by γ-ray sources for insect control. Electron irradiation of wheat and γ irradiation of citrus are also under consideration by the FDA. Current estimates of costs for treating grain with radiation are somewhat higher than costs for chemical insecticide treatment. As the nuclear and electronic industries develop further, however, costs for ionizing radiation are expected to decline substantially. Foodstuffs do not become radioactive when approved radiation sources are used and there are no chemical residue problems. Therefore, the eventual application of radiation for control of stored-product insects can be expected. (BBB)

26705 STUDIES ON THE ERADICATION OF ANOPHELES PHAROENSIS THEOBALD BY THE STERILE-MALE TECHNIQUE USING ^{60}Co. I. BIOLOGICAL EFFECTS OF GAMMA RADIATION ON THE DIFFERENT DEVELOPMENTAL STAGES. Abdel-Malek, A. A.; Tantawy, A. O.; Wakid, A. M. (Middle Eastern Regional Radioisotope Center for the Arab Countries, Cairo). J. Econ. Entomol., 59: 672-8(June 1966).

Mosquito pupae were subjected to cobalt-60 γ-radiation doses from 500 to 7000 R, with 500 R increments, to study the biological effects of radiation on fitness components. Radiation caused a significant increase in egg production at 1000 R, after which there was a gradual decrease, becoming significantly different from controls at 2000 R. It also caused a significant decline in the percentage of larvae hatching at all doses, with a highly significant decrease at higher doses of irradiation as compared with the controls. At 5000 to 7000 R, hatchability was less than 1%. No significant effects on the percentage pupation or percentage emergence were seen except at 4500 R. At 4500 R, eggs hatched to larvae but never pupated. Females lived longer than males, but γ rays had no effect in general on adult longevity. At higher and lower doses the survival rates of irradiated males and females were higher than their corresponding controls, females being superior to males. It is of interest from the standpoint of a sterile-male program that irradiated *A. pharoensis*, particularly at higher doses, is adversely affected in its fitness components except for longevity; irradiated adults may live longer than controls. (BBB)

26706 USE OF GAMMA-RAY-STERILISED CELLOPHANE MEMBRANES IN KIIL KIDNEY. Berlyne, G. M. (Manchester Royal Infirmary, Eng.); Crooks, L. G. pp 285-8 of Proc. European Dialysis and Transplant Assoc. Vol. 2. 1965. Kerr, David N. S. (ed.). Amsterdam, Exerpta Medica Foundation, 1966.

The use of γ-ray-sterilized dialysis membranes in an artificial kidney was demonstrated. The dialysis membrane consists of cellophane folded into two layers, placed in a polythene envelope, and irradiated with γ rays (2.5 Mrad). Cost is 15 shillings per cannister, sufficient for 10 kiil kidney dialyses. The technique whereby the radiosterilized membranes are inserted into the apparatus is described in detail and illustrated. It is concluded that, for this type of artificial kidney, γ-ray-sterilized membranes are the method of choice. Sterilization is always complete and is cheap. One technician alone can prepare an artificial kidney ready for instant use within 15 min. Dialysance is not affected by γ irradiation. (BBB)

26707 X-RAY EQUIPMENT FOR FOOD IRRADIATION. Rajewsky, B. (Max-Planck-Institut fuer Biophysik, Frankfurt am Main). pp 67-79 of STI-PUB-127.

To investigate the different problems in radiation biophysics and radiation biology involved in the radiopreservation of foods the necessity to develop equipment with a very high output of x rays became evident at the beginning of the 1940's. This equipment made it possible to produce much higher dose-rates than the technical constructions which existed at that time. Such equipment was developed in the Federal Republic of Germany between 1950 and 1953 and has been in use since then for scientific research. It later became clear that these x-ray machines are also very suitable for the sterilization and disinfection of drugs, food, and other materials. Three types of equipment are used. With the construction of the AEG x-ray equipment of 120 kV and 500 mA, the industrial technique has been adopted and gradually implemented. The equipment had three different types of x-ray tubes which can be connected with a high-voltage transformer of 240 kVA. These tubes run continuously, or for a short time, with a tube current of 2A and a voltage of up to 100 kV. The radiation dose-rate amounts to 10^7 R/min. These tubes permit irradiation with continuous conveyance of a great amount of irradiation material. The corresponding industrial equipment constructed up to now is described. (auth)

26708 HIGH-ENERGY ELECTRON AND GAMMA RADIATION PLANT: DESIGN, CONSTRUCTION AND ECONOMICS. Jefferson, S. (Wantage Research Lab., Eng.). pp 21-32 of STI-PUB–127.

Industrial uses of ionizing radiation are now well established; existing installations in the United Kingdom are described. The plants designed to process pre-packaged and bulk material are the most relevant to food processing. Both high-energy electrons and gamma rays are being used on an increasing scale for the sterilization of medical supplies. The relative merits of both types of plant are discussed. The economics of operation are largely influenced by the cost of radiation, the throughput handled, the dose required, the efficiency of utilization of the radiation, and the uniformity of loading throughout the year. When specific installations are being considered, attention must be given to additional costs, such as packaging of the product prior to irradiation, transport, dwell-time in the plant, and the possible need for a buffer store. (auth)

26709 CHEMICAL EFFECTS OF ^{60}Co GAMMA RADIATION ON THE CONSTITUENT ELEMENTS OF FOODSTUFFS: ACTION ON GLUCIDES. Thieulin, G.; Basille, D.; Morre, J.; Cumont, G. (Service Veterinaire Sanitaire, Paris. Departement de la Seine, Paris). pp 187-95 of STI-PUB–127. (In French).

The experimental study of the changes undergone by a food commodity, such as meat, under the action of cobalt-60 radiation, poses difficult problems in view of the chemical complexity of the material treated. For this reason the authors considered it necessary to begin their study by attempting to show the effects of the action of these radiations on the elementary components of muscular tissue, and turned their attention to the glucosides. Sixteen simple glucosides and monosaccharides and their derivatives were investigated. In view of its biological importance, particular attention was given to galactose. A particular feature of the work was the addition of sodium borate to the sugars before exposure to radiation. Degradation of the glucosides was assessed by qualitative and quantitative investigation of the malonic aldehyde produced. The thiobarbituric acid reaction was used; spectrophotometric measurement was carried out at 268 and 535 nm, and differentiation with glyoxal was performed. The work showed that at pH 9.5 and dilution 0.001 *M* borated sugars are from 2 to 12 times more sensitive to radiation than pure sugars and maximum sensitivity is obtained for equimolecular mixtures. (auth)

26710 PHYSICAL AND CHEMICAL ANALYSIS OF THE GERMINATING AND NUTRITIONAL PROPERTIES OF IRRADIATED WHEAT. Pahissa Campa, J. (Comision Nacional de Energia Atomica, Buenos Aires); Gabarain, R. V. A.; de Pahissa, M. H. H.; Bassa, L. pp 231-42 of STI-PUB–127. (In Portuguese).

Wheat was exposed to radiation at various dose levels for the purpose of determining the physical and chemical effects on whole grain (its behavior as seed) and flour (nutritional value). A Canadian Gammacell 220 apparatus was employed, equipped with a 13,000-Ci ^{60}Co source and capable of delivering a dose of approximately 1 Mrad/hr. Irradiation was carried out at the following dose levels: 10, 15, 20, 50, 100, 150, 200, 300, 500, 1000, 1500, and 2000 krad. The following analytical values were determined: for whole wheat, hectolitric weight, moisture content, percentage of proteins (nitrogen content × 13.5), Zeleny figure, ash content, ability to germinate (two and three days); for flour, moisture content, percentage of proteins (nitrogen content × 13.5), Zeleny figure, ash content, alcoholic acidity, maltose content, wet gluten content, dry gluten content, farinograph values (absorption of water, development time, degree of sponginess, Brabender moisture tester), alveograph values (stretch-resistance, stretch, degree and rate of deformation, ratio of stretch-resistance to stretch), extensometer values (work required to stretch dough, stretch-resistance, stretch, ratio of stretch-resistance to stretch), bread-making characteristics (weight of bread, volume of bread, and specific volume). The same values were also determined for non-irradiated wheat. Sufficient quantities of wheat were irradiated to permit analyses of samples after different periods of time had elapsed. The analytical values were found to vary with dose, marked differences (with respect to the control sample) being noted in the texture, odor, color, and taste of bread made with wheat that had received the highest doses. To determine changes in nutritional value the irradiated wheat was included in the diet of rats, both immediately following irradiation and after various periods of time had elapsed. The development of the rats, in particular that of their blood picture and bone marrow, was then closely followed. (auth)

26711 IRRADIATION OF DRIED ALBUMIN FROM CATTLE BLOOD: A BACTERIOLOGICAL STUDY. Turjanski, L. (Comision Nacional de Energia Atomica, Buenos Aires); Kramar, E.; Mugliaroli, H. A.; Pezzolante, R.; Casos, C. C.; Ambesi, A. pp 321-8 of STI-PUB-127. (In Portuguese).

Results are reported from a bacteriological study of irradiated albumin obtained from the blood of cattle. The albumin was obtained by drying blood collected in bulk at a slaughterhouse. The blood was separated by centrifuging into two fractions, white and red, the white fraction containing plasma, leukocytes, and platelets, and the red fraction consisting of erythrocytes. The albumin was contaminated by microbes due to the impossibility of extracting the amount of blood involved (100,000 liters daily) under aseptic conditions, transport of microbes in the blood during slaughter, possible contamination by the blood of sick animals (veterinary examinations are carried out after extraction of the blood), and contamination caused by actual carcass processing. This material is used as a fertilizer, and for other industrial applications, and only in a minor degree for human nutrition. The reaction of the bacterial flora to gamma radiation was studied with the aid of a Gammacell 220 apparatus operating in the dose range 0.5 to 4 Mrad. In the first test the whole material was irradiated, and total and differential counts performed for the purpose of identifying the different strains of bacteria present. The isolated bacterial flora was then studied together with the particular response, in each case, to different radiation doses. Changes in the biochemical behavior of some strains after irradiation are described. (auth)

26712 APPLICATION OF RADIATION FOR THE CONTROL OF SALMONELLAE IN VARIOUS FOODS. Ley, F. J. (Wantage Research Lab., Eng.). pp 349-62 of STI-PUB-127.

Microbiological studies on the use of ionizing radiation for the elimination of Salmonellae from various foods have demonstrated that a wide variety of factors can influence the radiation sensitivity of these organisms. These factors include the nature of the food itself and the temperature during irradiation, e.g., whether frozen or unfrozen. The difference in resistance of different serotypes of Salmonellae irradiated under the same conditions has also been well established. Dose/survival curves constructed for the purpose of making a choice of dose for a particular application must therefore be established for the practical conditions envisaged and be based on the most resistant serotype present. Since these conditions can never be exactly reproduced in the laboratory, the choice of dose should be confirmed by a substantial amount of work with the naturally-contaminated material. It is apparent that the doses required for the treatment of various foods lie within the range 0.5 to 1.0 Mrad, achieving a reduction in numbers of initial populations by a factor of between 10^5 and 10^7. The most promising processes are those considered for frozen and dried-egg products, frozen meats, and animal feeds. (auth)

26713 IRRADIATION AS A QUARANTINE CONTROL MEASURE. Cornwell, P. B. (Rentokil Labs. Ltd., Felcourt, Eng.). pp 381-93 of STI-PUB-127.

Of 446,000 consignments inspected at US ports of entry last year, 32,000 were infested. The vast increase in international travel, exchange of goods in trade, and the speed of movement from one part of the world to another requires strict measures to prevent worldwide dissemination of insect pest species. Once an exotic species is established, quarantine surveys of pest abundance, distribution, and spread show that great efforts are required to effect eradication. The establishment of irradiation facilities for the treatment of certain commodities, at import or export, or interstate collecting centers, as a possible answer to this problem and to replace existing techniques of fumigation is discussed. Examples are given of the possible use of irradiation to treat passengers' baggage at airports, to prevent the spread of pests of fruit crops across inter-state boundaries, and for the treatment of timber at import. Sustained release of sterilized insects as a continuous control operation is considered as a possible replacement for quarantine survey and treatment of pest containment areas. (auth)

26714 TECHNICAL AND ECONOMIC CONSIDERATIONS IN THE PRESERVATION OF MEATS AND POULTRY BY IONIZING RADIATION. Urbain, W. M. (Michigan State Univ., East Lansing). pp 397-409 of STI-PUB-127.

Radiation-sterilized meats and poultry can be of a quality better than that obtained with thermal processing. Where the normal method of preservation of meat and poultry during distribution is refrigeration, radiation at sterilizing levels is not likely to replace it. A principal reason for this is cost. In such a civilian market, radiation-sterilized meats will serve primarily as convenience foods. Radiation-pasteurization could provide a significant product life extension for fresh meats and poultry by delaying microbial spoilage, especially in the centralized preparation of retail cuts. Other factors of meat spoilage of a chemical or physical nature, however, are not controlled by radiation, and until they are, there is no real marketing value in the use of radiation. For fresh or frozen poultry there is the possibility of Salmonella control, should this be needed. Costs for sterilization and pasteurization are estimated and are presented in a form to permit selection of specific conditions within a range for certain important variables. From a commercial viewpoint, it is important to determine the consumer acceptance of radiation-sterilized meats and poultry. The usual approach to such a determination is to market the products in question in a limited manner and to measure the acceptance under such market conditions. To accomplish this with radiation-sterilized foods, the next step appears to be to obtain a production capability to supply the products for test marketing. (auth)

26715 RADIATION TREATMENT OF MEAT PRODUCTS AND ANIMAL BY-PRODUCTS. Hansen, P. -I. E. (Danish Meat Research Inst., Roskilde, Denmark). pp 411-26 of STI-PUB-127.

Application of radiation in food technology can only be considered as an alternative to existing preservation methods when a higher quality product and/or a cheaper product will result, or in cases where no alternative methods exist. With this view in mind, work performed at the Danish Meat Research Institute on sliced bacon, canned hams, luncheon meat, and animal feeds, i.e., meat and bone meal and blood meal, is reviewed and discussed. The conclusion drawn from the experimental results is that the formation of off-flavors in irradiated meat products is a very serious problem and the most important obstacle to a successful application of irradiation in meat processing. It is, therefore, essential that future research should concentrate on finding means to reduce the irradiation flavor. A number of approaches to solve this problem are mentioned and the Danish work in this field which has been centered mainly on the use of very high dose-rates and of non-equal dose distribution in cans is reviewed, and the concepts are briefly described. (auth)

26716 IRRADIATION OF POULTRY AND EGG PRODUCTS. Thornley, Margaret J. (Cambridge Univ., Eng.). pp 427-37 of STI-PUB-127.

Poultry and egg products may be treated advantageously with various kinds of irradiation processes, in different circumstances. Where contamination with Salmonella is a problem, pasteurization may be carried out with doses of the order of 0.5 Mrad. This is particularly valuable for frozen products, such as whole egg and some kinds of poultry, especially duck. Dried-egg products may be treated also in this way. The treatment of poultry carcasses so that they can be stored indefinitely can be achieved by doses of 4.5 Mrad. However, other processes must be associated with the irradiation, to prevent undesirable off-flavors. These can include preheating to inactivate enzymes, irradiation in the frozen state, in vacuum or nitrogen packs, or with activated charcoal included in the pack, and particular methods of cooking are sometimes recommended. These methods are of interest for army use, and have been extensively studied for the research program of the United States Army. The process for poultry, i.e., increase in storage life by radioinduced inactivation of most of the spoilage microorganisms, is of interest for commercial use. Doses ranging from 0.15 to 0.25 Mrad may be used without adverse effects on flavor, and will extend the period before microbial spoilage by 1.5- to 3-fold. Storage at chill temperatures (5°C or below) is necessary, and changes in flavor during storage may limit the extension of this period, so that 20 days at 1°C is about the most obtainable without quality deterioration. The mechanism of these changes is not understood, but they are not due to microbial spoilage or to the irradiation. The eventual microbial spoilage of irradiated chickens at chill temperatures is due to non-pathogenic bacteria, which are normally present in the spoilage flora, though sometimes the proportions of different kinds of these bacteria may be altered, giving rather different odors. The application of this process to British conditions for production and distribution of broiler chickens has been studied, and a joint investigation by the United States Atomic Energy Commission, the Atomic Energy of Canada Ltd., and the United States Army Material Command's Natick Laboratories is now in progress. This will cover economic needs and advantages, wholesomeness, product development, packaging and consumer acceptance. (auth)

26717 STUDY OF COMBINED TREATMENT FOR DAMP-HARVESTED MAIZE: GAMMA IRRADIATION AND DRYING BY CONTROLLED VENTILATION. Saint-Lebe, L. (Centre d'Etudes Nucleaires, Cadarache, France); Pelegrin, P.; Guilbot, A. pp 439-54 of STI-PUB-127. (In French).

The purpose of combining the effects of gamma irradiation from ^{60}Co and of slow drying by cool ventilation (10 to 25°C) in storage chambers for the processing of maize is to replace the standard technique of rapid drying with high temperature air by a treatment which is less likely to damage the grain and also disinfects at the microbiological level. In France, one million tons of damp maize are involved (1964); the problem is to be regarded as one of increasing importance both in Europe and in tropical countries. The direct effect of gamma radiation on the yield and technical characteristics of the starch were studied. The latter was extracted from the maize by a laboratory method which faithfully and accurately reproduces industrial conditions. Radiation doses of less than 500 Krad were found to have no effect on the extraction yield, whereas drying at 74°C lowered the yield by about 4% because of the partial coagulation of the protein network and the bursting of starch granules. The slight changes in structure of the irradiated starch are in most cases advantageous from the viewpoint of further treatment of the product. They may lead to the development of a test to ascertain whether the starch or the maize have been irradiated. Microbiological analysis techniques suitable for defining the optimum conditions for radiopasteurization of maize in relation to the environment were developed. (auth)

26718 RADIATION DISINFESTATION OF GRAIN AND SEEDS. Golumbic, C.; Davis, D. F. (Dept. of Agriculture, Hyattsville, Md.). pp 473-87 of STI-PUB-127.

Current interest in the radiation treatment of grain and seeds mainly revolves about its efficacy for control of insect infestations in these products. The recent literature on this subject is reviewed and gaps still existing in the fundamental and practical knowledge of radiation disinfestation are pointed out. Research programs in the United States Department of Agriculture that are under way, or planned for the immediate future, are discussed in detail. Current studies are being directed toward establishing minimum effective doses for sexual sterilization and mortality, influence of environmental factors on dose requirements, and potential for the development of biological resistance. In May 1966 the scope of the work expanded as a new grain products irradiator became operative and applied studies were initiated. An integral part of this research is a study of the effect of irradiation on the quality of food and feed grains and on cereal products, at the doses for both insect control and fungal disinfection. This paper examines critically the results of research in this area and estimates future research needs. (auth)

26719 STATUS OF IRRADIATION CONTROL OF INSECTS IN GRAIN. Cornwell, P. B. (Rentokil Labs. Ltd., East Grinstead, Eng.). pp 455-70 of STI-PUB-127.

Research on the uses of ionizing radiations for the control of insects infesting stored foodstuffs has demonstrated the technical feasibility of irradiation for the treatment of grain. Studies in radiation entomology have established the susceptibilities of the principal grain storage insects and the extent to which environmental factors may modify the efficacy of treatment. Investigations into chemical and physical properties of irradiated grain have shown no adverse effects on organoleptic and manufacturing properties at the dose level required for disinfestation. Work on the wholesomeness of irradiated grain has shown no loss in nutritional adequacy, with the result that clearance has been given in the United States for the human consumption of irradiated wheat and wheat products. Engineering considerations suggest that irradiation is an economic competitor to chemical methods for the treatment of grain at large exporting or collecting centers. With bulk storage and automated conveying systems now established as the most expedient method of handling grain between producers and consumers, it can be wisely predicted that implementation of radiation disinfestation into the grain handling industry will follow in the foreseeable future. Information on infestation problems and the grain-handling industries of various countries is used to illustrate the likely future potential of irradiation for the treatment of grain on an international scale. (auth)

26720 PRESENT STATUS AND FUTURE PROSPECTS OF IRRADIATION PRESERVATION FOR FISH. Shewan, J. M. (Torry Research Station, Aberdeen, Scotland). pp 489-506 of STI-PUB-127.

All the present evidence seems to show that radiation sterilization of almost all kinds of sea foods is not a practical proposition owing to the production of undesirable organoleptic changes, mainly in flavor and odor, of the cooked product. On the other hand, a variety of sea foods (including about 30 species of fish and shellfish) can withstand pasteurizing doses of from 0.3 to 0.5 Mrad without any such organoleptic changes being detectable. Moreover, the shelf life of such irradiated products, in terms of good commercial quality, can be extended by factors of approximately 1.5 and 2 times at storage temperatures of 40 and 32°F respectively. Thus, newly-caught cod and haddock which remain of good quality for a shelf life of 9 and 12 days at 40 and 32°F can, after irradiation at 0.3 Mrad, still have similar qualities after storage at these temperatures for approximately 14 and 24 days, respectively. To obtain the maximum extension of storage life, irradiation on board the fishing vessel would be the most appropriate, but the technical difficulties of such a task are formidable. Most of the white fish, such as cod and haddock, are not landed immediately after catching but may be anything from a few hours old up to the limit of edibility, viz. about 17 days for well-iced cod at 32°F at landing. Accordingly, the longer the fish have been stored in the fishing vessel before landing the shorter the remaining life on shore. Taking the storage limit of good commercial quality cod and haddock as being 9 and 12 days at 40 and 32°F respectively, experiment has shown that the remaining shelf life of such species on landing can be extended by factors of approximately 1.5 and 2 at 40 and 32°F. Thus, cod or haddock stored for six days at 32°F before landing would have their subsequent storage life of six days at landing extended to twelve if irradiated. Feasibility studies indicated that the radiation pasteurization of fillets of fish and of other sea foods in the packaged form is most likely to be immediately commercially successful. Wholesomeness studies, and studies of bacterial hazards, particularly from Clostridium botulinum Type E, in the production and marketing of such packaged products, are now under way, and the present position of some of these and other aspects of the irradiation of such products are discussed in detail. (auth)

26721 STATUS OF RESEARCH AND DEVELOPMENTAL STUDIES ON RADIATION PASTEURIZATION OF FISH AND SHELLFISH IN THE UNITED STATES. Slavin, J. W.; Ronsivalli, L. J.; Connors, T. J. (Bureau of Commercial Fisheries, Gloucester, Mass.). pp 509-33 of STI-PUB-127.

The status of research on radiation-pasteurization of fish and shell fish in the United States is reviewed and plans for commercialization of the process are described. Laboratory studies at universities and governmental research institutions on quality and microbiological aspects of irradiated sea food; developmental investigations on irradiating fish ashore and at sea; and United States clearance of radiationpasteurized sea food and use of the process in the fishing industry are discussed. Quality studies indicate that irradiation with cobalt-60 at levels of 150,000 to 450,000 rad can at least double the refrigerated shelf life of 16 species of fish and shell fish, which include the major species marketed as fresh or frozen in the United States. Storage temperature, quality of raw material, and dose level significantly affect product quality and shelf life; packaging is of less significance. Synergistic systems, using bactericidal salts or heat, in conjunction with radiation, effectively destroy bacteria and offer promise in reducing radiation levels and extending product shelf life over that when radiation is used alone. Irradiation at very low levels significantly changes the microbial flora of fish fillets, but interestingly enough this change is no greater than that which occurs when storing the product in an anaerobic environment. In discussing microbiological changes in irradiated and non-irradiated fish, the authors point out that treated fish fillets are as safe and wholesome as the non-treated fish. Work on safety aspects of irradiated fish fillets is discussed in detail. Developmental studies received emphasis with construction and operation of a 250,000 Ci cobalt-60 fish-processing facility at Gloucester, Mass. Tests on packaging and shipping irradiated products under simulated commercial conditions show that pasteurized fish can be handled in the same manner as fresh fish, with a resultant doubling of shelf life for the former. In co-operation with private and governmental organizations, irradiated sea foods have been shipped across the United States in commercial carriers and evaluated for quality. Results are very encouraging and indicate that the process would be extremely valuable to industry. Irradiation of fish at sea shows promise as a means of increasing the landings of fresh fish. Preliminary findings indicate that it may be feasible to irradiate eviscerated groundfish at sea with levels less than 100,000 rad and then reirradiate the fish ashore after filleting and packaging. (auth)

26722 INVESTIGATIONS ON PASTEURIZATION OF COLD MARINADES BY ^{60}Co GAMMA RAYS. Schoenborn, W.; Kinkel, H. J.; Hafferl, W. (Battelle Institut, Frankfurt am Main). pp 549-59 of STI-PUB-127.

Marinated herring fillets are a fish product matured under the action of acetic acid and salt and marketed in a spiced brine containing about 3% salt and acetic acid (pH 4). Since the usual addition of the preservative hexamethylene-tetramine has been restricted to a limited period of time by the new German food law, investigations were made on pasteurization by means of ionizing rays, as a new method of preservation without the addition of other preservatives. Decay of this food product was caused by heterofermentative lactic-acid bacteria, which decarboxylated the amino acids set free from the protein; the decay was a result of carbon dioxide bombardment. The marinades were packed into flat tins holding about 125 g, and exposed to ^{60}Co gamma rays from an under-water source, while being cooled. The shelf life of the tinned marinades was extended by the irradiation. The period up to bombardment at 15°C was three times as long as usual in cases of irradiation with 155 krad. The critical number of 1 million germs per ml at 15°C was also reached after a period three times as long as usual upon irradiation with 160 krad. The LD_{99} of three isolated strains of lactic-acid bacteria irradiated in a salt-peptone solution was 113, 165, and 144 Krad, respectively. Since at 15°C the growth of the germs is retarded, while at 20°C it is practically unrestrained, the period of durability at a storage temperature of 18°C could only be doubled by irradiation with 280 Krad. The organoleptic tests were based on preference analyses by means of the nine-step Hedonic scale, and on difference tests (triangle test), and were performed by a panel. At 70 Krad the taste was still acceptable, at 140 Krad there is a distinct flavor change, and at 280 Krad the taste was disagreeable. A distinct improvement in taste was achieved by irradiation at low temperatures (−30°C) and by the addition of ascorbic acid, sorbitol, and spices. (auth)

26723 RECENT ADVANCES IN FOOD IRRADIATION RESEARCH IN JAPAN. Matsuyama, A. (Inst. of Physical and Chemical Research, Tokyo). pp 767-84 of STI-PUB-127.

The current trend towards establishing a national program on food irradiation in Japan appears to be maturing with great interest in fundamental and practical problems. Efforts of the Atomic Energy Commission to devise a program on development studies, and their practical application, which will probably commence in 1967, are now being made. The collaboration of researchers in this field has resulted in the setting-up of the Japanese Research Association for Food Irradiation. This organization is expected to play an important role in promoting the national program. At present there are in Japan about 30 KCi-scale sources of γ-emitting radioisotopes, and almost the same number of electron generators, including some pilot-scale irradiation facilities. Practical studies on food irradiation in Japan are classified into three categories, in terms of their purpose. The first is radiation preservation, to which major efforts have been devoted. Emphasis is placed on sprout inhibition of potatoes, onions, and sweet potatoes; disinfestation of rice, wheat, and their products; low-dose treatment of vacuum-sealed fish and shell-fish with doses of less than 0.5 Mrad; and of some fruits, such as strawberry and orange. The first interesting observation was in rice irradiation where, at 5000 to 20,000 rad disinfestation dose, quality changes detectable immediately after irradiation became insignificant after eight months' storage according to the statistical analysis of organoleptic data. The second was in connection with studies on the elimination of harmful biological and biochemical factors in foods from the viewpoint of public health. Radiation sensitivity of the toxin production by Clostridium botulinum, Type E, was investigated in studying the wholesomeness of irradiated foods. The third was concerned with the utilization of the chemical effect of radiation. For example, studies were made of the irradiation of marine algae with 0.5 to 0.7 Mrad to improve quality and the yield of extracted agar and the radiation acceleration of the ageing of alcoholic beverages, particularly distilled liquors, with doses of up to 0.5 Mrad. Besides these practical investigations, extensive work was conducted with the fundamental aspects, including the radiosensitization of microorganisms, enzyme inactivation by radiation, and other subjects in radiation chemistry associated with food irradiation. (auth)

26724 ELECTRICAL PARAMETERS FOR EVALUATING THE STATE OF PRESERVATION OF FISH. Turjanski, L.; Kramar, E. (Comision Nacional de Energia Atomica, Buenos Aires). pp 211-17 of STI-PUB-127. (In Portuguese).

In fish irradiation experiments it is important to have a simple method of obtaining quantitative data for evaluating the state of preservation of the irradiated material. With this object in view, certain electrical parameters of fish species that are of importance as a source of food were studied. Measurements were made on non-irradiated fish, with electrode-carrying pincers and a tester as commonly used in electronics. The results are presented of capacitance and resistance measurements carried out either with naked electrodes in contact with the exterior of the fish or with an electrolytic paste interposed for better conductivity. The experiments were then repeated with irradiated fish. A comparative analysis was made of the results, and their possible usefulness as a parameter in irradiation experiments is discussed. (auth)

26725 WHOLESOMENESS AND PUBLIC HEALTH RESEARCH IN THE UNITED STATES ATOMIC ENERGY COMMISSION FOOD IRRADIATION PROGRAMME. Whitehair, L. A. (Atomic Energy Commission, Washington, D. C.). pp 137-45 of STI-PUB-127.

To assess the biological safety of foods which are of interest to the Atomic Energy Commission's irradiated food program, studies have been sponsored by the Commission's Division of Biology and Medicine since 1961. Wholesomeness, microbiological, and biochemical studies have been undertaken with a view to complementing data derived from developmental, economic, and technological research studies sponsored by the Commission's Division of Isotopes Development. When these aspects appear feasible for specific low-dose irradiated foods, studies are initiated to provide relevant data required by the United States Food and Drug Administration before final judgements can be made on petitions for unlimited human consumption. Toxicity studies on several species of animals which are fed diets containing up to 35% (dry solids basis) of the irradiated food in question have been included in this program. Investigations of two years' duration on animals (rats, dogs, and chickens) provide data concerning food consumption, growth rate, enzyme systems, hematology, gross pathology, and histopathology. Shorter-term studies of a confirmatory nature on two animal species (rat and dog) are employed in certain cases when the irradiated food in question is sufficiently related to foods which have previously undergone long-term toxicity studies. Results to date of chronic toxicity studies on soft-shell clams and subacute toxicity studies on strawberries, apples, pears, sweet cherries, apricots, plums, and onions are discussed. Microbiological studies have been concentrated primarily on potentially pathogenic organisms. Studies have been in progress to evaluate carefully the conditions governing radiation and heat resistance, sporulation, outgrowth, and toxin production of Clostridium botulinum Type E. The natural incidence of Type E organisms in certain marine products and ocean environments is being investigated. Findings in the microbiological studies are discussed. Studies to date have indicated that the general outlook for wholesomeness of irradiated foods is favorable. Toxicity evaluations are currently being initiated on bananas, mangoes, and papayas. Research efforts on Clostridium botulinum, Types E and F, Salmonellae, and other pathogenic organisms will continue. (auth)

26726 UNITED KINGDOM FOOD IRRADIATION PROGRAMME: WHOLESOMENESS ASPECTS. Hickman, J. R. (Wantage Research Lab., Eng.). pp 101 of STI-PUB-127.

Tests for wholesomeness carried out in the United Kingdom as a part of the food irradiation program are described. Both short-term animal feeding studies in rats, chickens, and pigs, and long-term studies in rats and mice, failed to demonstrate any adverse effects attributable to the consumption of irradiated food by the animals. The animal feeding tests were designed with specific irradiation processes in mind, and all of these processes involved the use of low or moderate radiation doses. Thus, grain treated with 20,000 and 200,000 rad gamma radiation, and frozen egg (irradiated to kill Salmonellae) treated with 0.5 and 1.0 Mrad were tested by feeding to animals. Ham, irradiated with 250,000 rad to prolong its shelf life, was tested, and also ham irradiated with 2 Mrad. Currently, long-term studies are in progress to investigate the wholesomeness of fish treated with 0.6 Mrad (the maximum dose likely to be used to provide extended refrigerated (0° to 4°C) storage life). Short-term tests have also been undertaken with potatoes (10,000 rad) and horse flesh (0.65 Mrad). The nutritional quality of irradiated grain, egg, fish, and some animal feeds was investigated, using microbiological assay techniques. Losses in the B vitamins have been found comparable with those reported by workers in the United States and are of the same order of magnitude as losses occurring on heating, although differences were observed in the sensitivity of individual vitamins towards heat and irradiation. The losses in B vitamins occurring on irradiation and cooking were found to be additive. No effects on the nutritional value of protein were found. In 1962 the United Kingdom Ministry of Health set up a Working Party to review the effects of irradiation on food, and to report on the necessity for official control. The report of the working party, published in 1964, is discussed in relation to the wholesomeness tests carried out in the United Kingdom. (auth)

26727 FOOD IRRADIATION RESEARCH AND PILOT FACILITIES IN OPERATION OR PLANNED IN INDIA. Kumta, U. S.; Sreenivasan, A. (Atomic Energy Establishment, Trombay, India). pp 785-803 of STI-PUB-127.

The use of cobalt-60 gamma radiation has been studied for the delayed ripening in certain tropical fruits; sterilization, with combined use of mild heat, of fruits and vegetables; extension in shelf life of semi-dried fruits; and sprout inhibition in potatoes and onions. The technological merits of gamma-radiation processing for sea foods have been assessed by sensory evaluation for organoleptic attributes, bacterial load, chemical indices of spoilage, and qualitative and quantitative shifts in spoilage flora. Radiation pasteurization (0.4 Mrad) augments the storage life of non-fat fish like Bombay duck for 21 and 45 days, respectively, when stored at 10 to 12°C and 0 to 4°C, as against rapid putrefication of the fish within 3 days. A combination process, consisting of blanching (4 min), followed by low-dose irradiation (0.15 Mrad), extends the storage life of shrimps for 90 days at 0 to 4°C. Without the blanching step, shrimps keep well for 60 days; the unirradiated control spoils within 3 days. A dehydro-irradiation process, developed for Bombay duck and shrimps, prolongs the storage life of the semi-dried products (40% moisture) at room temperature (25 to 28°C) for over 150 days. The process has been studied in relation to the tolerance radiation dose, the synergistic effect of sorbic acid, improvements in quality by other physical and chemical treatments, and the type of packaging material. The onset of molds and oxidative undesirable flavors in cheese can be retarded for about 20 days at room temperature by the combined use of low doses of radiation (0.1 and 0.2 Mrad) and sorbic acid-coated wrappers. Radiation damage to fish proteins has been studied for the degree of scission, aggregation, and electrophoretic mobility. Promising results have been obtained on the application of radiation for disinfestation of wheat and the extension in storage life of Indian bread. Compositional changes and nutritional studies on irradiated wheat are being continued. Irradiation facilities, present and planned, are described. The Food Irradiation and Processing Laboratory, to be completed shortly, will house a cobalt-60 package irradiator (100,000 Ci), a cobalt-60 portable grain irradiator (28,000 Ci) and other facilities for food processing, and analytical and research laboratories. The package irradiator is designed for a throughput of 100 lb/hr at 0.5 Mrad and the portable irradiator could handle 500 lb/hr of grain at 15 krad. (auth)

26728 ECONOMICS OF FOOD IRRADIATION. Killam, E. R.; Ketchum, H. W.; Deitch, J.; Osburn, J. W. Jr. (Dept. of Commerce, Washington, D. C.). pp 833-46 of STI-PUB-127.

Current developments relating to the prospects for commercial food irradiation in the United States are reviewed. Both technical and economic potentials vary widely for different food products subjected to the same or different types of treatment. Food irradiation processes and products are evaluated. Recent studies concerned with the economics of food irradiation are briefly reviewed and evaluated and findings and conclusions relating to economic potentials are summarized. Industry reactions to a proposed pilot plant meat irradiator, sponsored by the U. S. Army and U. S. AEC and coordinated by the Department of Commerce, are discussed and factors which will determine the future direction, extent, and commercial success of food preservation by ionizing irradiation are analysed. Developments in all these categories are essential for success, and if not achieved would be limiting factors. Nevertheless, the successful and profitable marketing of irradiated foods must finally be dependent upon customer acceptance and favorable cost versus benefit relations. Benefits will include lower costs and higher profits through spoilage reductions, extensions of shelf-life and shipping distances, market expansions, and quality improvements. Ultimately, the economic success of this new technology must depend upon the clear demonstration that these benefits will exceed the additional processing costs by a margin sufficient to induce the necessary private investments and willingness to accept related risks in this new field. (auth)

26729 THE USE OF IONIZING RADIATION AS A MEANS OF PROCESSING FOODSTUFFS FOR STORAGE: PRESENT STATUS AND FUTURE PROSPECTS. Rogachev, V. I. (All-Union Scientific Research Inst. for Canning and Vegetable Drying, Moscow). pp 805-8 of STI-PUB-127. (In Russian).

The use of ionizing radiation for processing foodstuffs is being studied in the USSR, particularly in connection with the prevention of sprouting in potatoes and onions; disinfestation of foodstuffs; suppression of microbe activity; either sterilization or partial inhibition of microflora activity to prolong the shelf life of various foodstuffs; and alterations in the ripening time of fruits and vegetables after harvesting. The status of work performed in recent years on each of these general topics is reviewed, and the prospects for the practical application of irradiation to a number of products are considered. Among the products in question are meat and meat products (raw and cooked semi-finished products and sausage products), domestic poultry, various fruits and vegetables, potatoes, wheat, dried fruits and vegetables, and dried food concentrates. Practical methods of irradiating potatoes and onions to prevent sprouting during storage have already been developed, and very soon it will be possible to use radiation for the disinfestation of foodstuffs on an industrial scale. (auth)

26730 ECONOMICS OF GRAIN IRRADIATION. Baines, B. D. (Nuclear Chemical Plant Ltd., London); Mosely, J. pp 813-30 of STI-PUB-127.

A grain irradiation plant was designed and is being built into an existing silo installation. From this experience actual costs of plant construction are available for a plant using cobalt-60 and this experience is incorporated in estimates for machine installations for high grain throughput. Costs are compared for plants of comparable complexity and they indicate those areas in which each type of plant is pre-eminently suitable and those areas where either type may be best, dependent upon local site conditions, the standard of local technology, and methods of operation. The two plants compared are described in sufficient detail to enable the precise extent of the equipment supply covered by the costs to be appreciated. The accounting methods employed have been discussed with industrial accountants to ensure that they are acceptable to the potential users. The methods employed are explained so that they can be applied to problems of a similar nature. (auth)

26731 ECONOMIC ASPECTS OF RADIATION TREATMENT. Leveque, P. (Centre d'Etudes Nucleaires, Saclay, France). pp 847-9 of STI-PUB-127. (In French).

The cost of treatment of foods by radioactive sources and machines is reviewed, with emphasis on the recent drop in price of radioisotopes, especially ^{137}Cs. This affects the cost both of the installed KW and of the KWhr of energy produced. In the light of the experience gained in the past three years it is possible to define the efficiencies and the load factors observed in plants in operation. It is true that in most cases these are treating medical equipment and supplies, but the problems are comparable. (auth)

26732 ECONOMICS OF FOOD IRRADIATION. Rindorf, H. (A/S Radest, Herstedoester, Denmark). pp 865-76 of STI-PUB-127.

Very reliable irradiation equipment is available now and for an industrialist it is largely an economic consideration whether he should go in for irradiation processing. In Denmark an industrial concern has now found it economically justifiable to establish a multi-purpose industrial plant, equipped with an American linac, and this facility will be used to process food. To date, few plants in the world have recorded actual cost experiences for industrial food processing, but cost figures from other fields may serve as a guide. In practical calculations it is convenient to divide the work into certain typical groups, e.g., facilities for bulk, medium, thin, and multi-purpose materials, but food products may come under any of these headings. Costs of irradiation depend on product properties, type of plant, annual and monthly quantities, radiation doses, control standards, special requirements for re-packing, or other additional handling, etc. Definite figures for a particular case must be based on an exact calculation, but for a preliminary judgement many general price-range indications are available to the industrialist, and for a variety of purposes it is already evident that irradiation processing is economically sound. Apart from plant economy it is advisable for the industrialist to study some general commercial problems also, such as consumer preference and marketing structure, for the commodity in question. This can often best be done by marketing a pilot production of some quality before final decisions are taken regarding major investments in highly-specialized equipment. For some products market testing has already been done with good results by existing research or production facilities, and indeed actual commercial marketing has been reported. Many food irradiation processes seem to be promising from an economic point of view. (auth)

26733 ASPECTS OF LEGISLATION ON IRRADIATED FOODS IN EUROPEAN COUNTRIES. Spaander, J. (National Inst. of Public Health, Utrecht). pp 897-913 of STI-PUB-127.

Clearance for the general distribution of irradiated foods, as well as for the technological procedures to be used, requires legislation. Legislation on food irradiation is still in progress in Europe. A short survey of the present situation is given. General lines of approach are emerging today and can already be distinguished in some national legislations. For the international exchange of irradiated foodstuffs, a coherent system for the control of these products is of primary importance. Useful guidelines aiming at harmonization of the national regulations to be established have already been issued by international organizations working on this subject. Lack of practical methods for detection and estimation of the amount of ionizing radiation supplied to irradiated foods makes it, for the time being, necessary to rely on a government licensing system to ensure the safety for consumption of these items. Bilateral or multilateral agreements between the interested governments on the mutual acceptance of their licensed products seem inevitable as long as there exists no international organization to assume responsibility for the safety of irradiated foods and enforcement of the requirements to be met by these products at the international level. The clearance for consumption and distribution of irradiated food has to be based on solid evidence on the nutritional, toxicological and microbiological safety of the food items under consideration. A free flow of information, and the use of common standards for the testing and evaluation of the evidence collected, as one of the most essential requirements for the establishment of international distribution of irradiated foods, is stipulated. (auth)

26734 SIMPLIFIED PROCEDURES FOR OBTAINING CLEARANCES OF FOODS PRESERVED BY IONIZING ENERGY. Josephson, E. S. (Army Natick Labs., Natick, Mass.). pp 881-90 of STI-PUB-127.

Highly acceptable wholesome shelf-stable bacon, ham, pork, beef, chicken, and shrimp have been produced using high doses of ionizing energy. Using doses below 1 Mrad, the shelf life of highly acceptable wholesome fish, wheat, and wheat products, oranges, and white potatoes can be extended. Before production in the United States can be scaled up to commercial quantities for the broad consumer market, approvals are required from the United States Food and Drug Administration (USFDA) and, for meats from mammals and birds, from the United States Department of Agriculture (USDA). These agencies have approved bacon, wheat, and wheat products, and white potatoes, following receipt and evaluation of petitions containing all pertinent information including description of the process to be used, food-package combination, the proposed radiation source, the dose range, dosimetry methods, wholesomeness and nutritional data, positive proof of microbiological safety, absence of measurable induced radioactivity, acceptance data from taste panelists, and storage and shipping data where applicable. Collecting the data required for successful petitions has proved to be both time-consuming and expensive. To improve this situation, the whole process of data collection and of writing the petitions is being reexamined in the interest of streamlining and expediting the process. Recommendations are offered relative to some of the means helpful in achieving this end. (auth)

26735 LEGISLATION AND IDENTIFICATION OF IRRADIATED FOODSTUFFS. Lafontaine, A. (Institut d'Hygiene et d'Epidemiologie, Brussels). pp 917-26 of STI-PUB-127. (In French).

Originally of purely military importance, the irradiation of food commodities is nowadays of increasing interest in the civilian sector, and commodities so treated will shortly be marketed. Protection of the health of the consumer should be the main element in arguments for and against this practice. In view of the uncertainties which make it difficult to take up a definite attitude to the problem as a whole, Belgium has preferred to adopt the principle of prohibition, with the possibility of progressively departing from this principle as further knowledge becomes available. The Royal Decree of 28 February 1963 prohibits the addition of radioactive substances to foodstuffs and the treatment of foodstuffs by ionizing radiations except when the addition or treatment is performed for research purposes and a specific license has been granted by the Ministry of Public Health. The import, possession, or transport of foodstuffs to which radioactive substances have been added or which have been treated by ionizing radiations are also prohibited. Similar prohibitions are applied in regard to two products of a somewhat similar nature to foodstuffs, i.e., medicaments and medical supplies which have been treated by ionizing radiations. With a view to progressive liberalization, however, considerable easing of the regulations is proposed as far as medical supplies are concerned. In spite of the lack of conviction in certain scientific circles regarding the wholesomeness of irradiated foods, it is likely that a number of processes will shortly be accepted. A number of countries have already authorized consumption of various irradiated foods and it is to be assumed that national barriers will be overcome by commercial ties. At the same time, some control is essential to ensure that the authorized processes are not applied to foods for which they have not been specified and to check that the permissible doses are not exceeded. Identification of irradiated food and, as appropriate, determination of the doses employed therefor constitute a national and an international problem. (auth)

26736 STERILIZATION OF PRESERVED FISH BY GAMMA RADIATION. Kardashev, A. V. (All-Union Scientific Research Inst. for Sea Fishing and Oceanography, Moscow). pp 561-6 of STI-PUB-127. (In Russian).

Experiments in which various vacuum-packed fish products (boiled, fried, and stuffed fish, fried fish fillets, hot-smoked fish) were subjected to irradiation showed that doses of 1.5 to 2.0 Mrad sterilize microorganisms on the products but have an adverse effect on their organoleptic properties. During storage the fat of the irradiated product is damaged by oxidation, and colloidal senescence of albuminous tissues accompanied by syneresis occurs. To prevent these undesirable changes the author tried lowering the pH of the product and introducing carotenoids, ascorbic acid, etc., using commercial tomato sauces and vegetable dressings for the purpose. Pieces of fish (catfish, carp, cod, pike, and perch) were cooked until ready for eating, placed in glass preserve jars and vacuum-sealed. For purposes of comparison, samples of the same products were autoclaved. The fish were then subjected to doses of 0.2 to 2.0 Mrad of gamma radiation from a ^{60}Co source at a dose-rate of 800 rads. Both the irradiated and autoclaved products were analysed immediately after processing, and again after certain temperature tests and periods of storage. Microbiological, chemical, electrophoretic, spectrophotometric, physico-chemical, and organoleptic tests were performed on them. It was shown that a dose of 1.5 Mrad is sufficient to sterilize such products. The bactericidal action of the radiation was more effective in these tests than in the irradiation of fresh fish. The quality of the irradiated product, both immediately after irradiation and after a year of storage, did not differ from the quality of unirradiated fish and was better than that of the autoclaved samples. Moreover, there was less change in the quality of the fat and a smaller reduction in the content of vitamins and amino acids in the irradiated product. Preserved fish products sterilized by gamma radiation can be kept for more than 2.5 years without any substantial changes. (auth)

26737 AFTER-RIPENING OF RED PEPPER (CAPSICUM ANNUUM) AS AFFECTED BY IONIZING RADIATION. Farkas, J.; Kiss, I.; Andrassy, Eva (Central Food Research Inst., Budapest). pp 601-7 of STI-PUB-127.

The direct effect of x rays on freshly picked, sweet red pepper at dose levels of between 0 and 800 krad, and on the after-ripening of red pepper at dose levels of between 0 and 100 Krad, was investigated. As an effect of the irradiation of between 400 and 800 Krad, the pericarps softened; the carotenoid content, however, was not substantially reduced, even at a dose of 800 Krad. During the nine weeks' storage period at room temperature, subsequent to irradiation, an increase of about 90% of the total pigment content, expressed as capsanthin, was observed in the samples not treated. The formation of the carotenoid pigments was accelerated, to some extent, by 80 rad, and substantially accelerated by treatment of 2 Krad. The samples treated at the 2 Krad level reached the same pigment content in three weeks as the control samples in eight weeks. In the radiation-treated samples, however, the pigment content decreased after the fourth to fifth week of storage. Dose levels above 10 Krad slowed down or inhibited the formation of carotenoids during storage (after ripening). The reducing sugar content and the rate of drying were not affected by 0 to 100 Krad doses. Since the several hundred kilorad irradiation doses needed to destroy, or substantially inhibit, the growth of moulds causing the deterioration of red pepper of high moisture content have a deleterious effect, the application of irradiation to decrease storage losses in fresh, picked red pepper does not seem to be advisable. The application, however, of the very low doses stimulating carotenoid formation does seem to be promising in view of shortening the after-ripening period and increasing the pigment content. Further investigations are needed to establish the most suitable storage conditions for the after-ripening of red peppers and the causes responsible for decrease in the carotenoid content of irradiated fruits in the second half of the storage period. (auth)

26738 IRRADIATION OF FRUIT AND VEGETABLES IN FRANCE. Vidal, P. (Conservatome, Lyon). pp 589-98 of STI-PUB-127. (In French).

France, thanks to its varied and temperate climate and the features of its soils, affords favorable conditions for the production of fruit and vegetables. In certain cases these conditions permit harvests covering a fairly long period of time. As a result of work on the choice of varieties and on the improvement of growing techniques, fruit and vegetable production has expanded and yields have increased. Techniques for increasing keeping periods and preserving quality are being developed, mainly on the basis of refrigeration. In some cases these techniques are inadequate, while in others their action is restricted. Irradiation seems capable of bringing new improvements, principally with regard to halting the germination of tubers, bulbs, and rhizomes, to the conservation of fruit and vegetables, when applied together with freezing, or, possibly, in a controlled atmosphere, and to the disinfestation of certain commodities. Work carried out in various countries, including France, shows the advantages of irradiation and the possibility of using it for French fruit and vegetables (strawberries, peaches, apricots, tomatoes, potatoes, garlic, onions). The introduction of irradiation will lead to changes in the production and distribution of fruit and vegetables. Distribution will be improved and more distant sales points may be reached. The use of irradiation will not alter operations required to prepare the products for commercial purposes. The characteristics of these installations (usually gamma facilities) will depend on many variable factors. In the light of the results obtained, the cost of irradiation would appear to lie within economic limits. The irradiation installations will operate mainly by radioisotope sources. The annual utilization factors of the installations play an important part in the cost of irradiation. Several procedures are envisaged to render them more economic, since their operation will necessarily be seasonal. The location of the installations will depend on factors involving the commodity, its keeping time, and its conditions of marketing. In general, the irradiation facilities will be situated at the points of production or consumption, preferably the former. For fruits, the facilities will be located at the point of production, preferably adjacent to packing and refrigeration plants. (auth)

26739 EXPERIENCES WITH THE IRRADIATION OF VEGETABLES IN THE NETHERLANDS. Staden, O. L. (Inst. for Research on the Storage and Processing of Horticultural Produce, Wageningen, Netherlands). pp 609-15 of STI-PUB-127.

Recent experiences in the Netherlands on the effect of irradiation (electrons and gamma rays) on different vegetables are reviewed. In this work main attention was given to the possibilities of prolonging the shelf life, namely, effects on the living product. The reaction of the tomato, among others, to electrons and gamma rays is discussed. These rays cause complete loss of the internal structure. Mention is made of the strong presumption that neckrot of the onion cannot be controlled by ionizing radiation, and some orienting trials with cut vegetables, packed in plastic and unpacked, are discussed. Possibility of the irradiation of mushrooms is reported more extensively; five favorable results were obtained. However, an experiment with times of processing successively postponed showed that the possibilities are less than was expected initially. Irradiation cannot be applied to sauerkraut due to discolourations which are rapidly manifested. Treatment of dried curly kale with 1.5-MeV electrons showed decreasing cooking time and rigidity with increasing krad doses, while samples treated with doses higher than 1000 krad became organoleptically unacceptable. (auth)

26740 REVIEW OF THE STATUS OF IRRADIATION EFFECTS ON CITRUS FRUITS. Dennison, R. A.; Ahmed, E. M. (Univ. of Florida, Gainesville). pp 619-33 of STI-PUB-127.

The United States fresh-market spoilage losses valued at the 1959 to 1963 retail prices were estimated for oranges and grapefruit to be $8.4 and $5.4 million, respectively. Stem-end rots and green and blue molds cause the greatest post-harvest decay losses to citrus. No single radiation dose can be given that will be the minimum required for protecting citrus fruits against spoilage. Radiation doses required for retarding old or established infections are higher than for the retardation of incipient infections. The flux, as well as the dose of gamma radiation influences the control of infections. Fresh citrus fruits undergo metabolic changes which ultimately lead to senescence. Some of these changes include varied activities in the levels of respiration, organic acids, sugars, pectic substances, and color. In many respects the loss of cellular vitality in senescence resembles the effects of radiation injury. Irradiation causes changes in the pectic components of fruit. In general, an increase occurs in the water and ammonium oxalate-soluble fractions and a decrease occurs in the sodium hydroxide-soluble fraction. A large increase of water-soluble pectin is found in the juice extracted from irradiated fruits. Apparently this increase results from movement of the water-soluble pectin from other parts of the fruit. A marked increase in the viscosity of the juice results. Peel injury is sometimes found following irradiation and storage of the fruit. The percentage of fruit showing peel injury and the severity of the injury increase the higher the storage temperature and the longer the storage duration. Oranges and grapefruit may be irradiated with doses of up to 200 krad without any appreciable deleterious effects on organoleptic qualities. (auth)

26741 IRRADIATION OF TROPICAL FRUITS AND VEGETABLES. Dharkar, S. D.; Sreenivasan, A. (Atomic Energy Establishment, Trombay, India). pp 635-49 of STI-PUB-127.

Experiments have been carried out on delayed ripening, through the use of cobalt-60 gamma radiation, of mangoes, showing a delay of up to six days by an optimum dose of 25 krad when irradiated in air, carbon dioxide or, preferably, nitrogen atmosphere. The effect of radiation on the skin of the fruit is more prominent in terms of inhibition in chlorophyll disappearance and carotenoid formation than in ripening changes in the meat of fruit. These studies have been extended to mangoes skin-coated with an emulsion made of an acetylated mono-glyceride preparation. Skin-coated fruits show physiological damage due to the excessive inhibition of respiration, which is offset by a spurt in respiratory activity when irradiated in air or nitrogen. An added delay of six days in ripening is achieved by combined skin-coating and irradiation. Other fruits studied include guavas, sapotas (sapodillas) and tomatoes, with all of which a delay in ripening of about five days could be effected with a dose of 20 to 25 krad. Fruits like chillies, bananas, and oranges do not show any delay in ripening on exposure to radiation, there being slight enhanced ripening with oranges. Semi-dried bananas (40% moisture), irradiated by 0.5 Mrad, keep well for at least three months, compared with the dehydrated (10% moisture) product which, besides being highly susceptible to mold infection, possesses poor attributes of color, flavor, retention of nutrients, and reconstitutability. Suitable combinations of heat treatment and irradiation have been successfully employed for the sterilization of mangoes, guavas, sapotas and apples where, usually, canned products with better texture, flavor and retention of nutritive qualities could be obtained with treatment at 70°C for 10 min and 400 krad. Likewise, excellent-quality canned peas are obtainable with the combined use of 800 krad and 100°C for 5 min. Orange juice could be radiation-sterilized by a combination of 400 krad and subsequent mild heat treatment at 50°C for 15 min. Sprouting could be inhibited in potatoes (10 krad) and onions (6 krad), resulting in shelf-life extension of 32 and 24 weeks, respectively, over the 8 weeks for the unirradiated controls. Basic researches relating to radiation preservation of fruits and vegetables include studies on the sensitization to radiation of spoilage microorganisms (Micrococcus radiodurans, Streptococcus faecalis) by previous ultrasonic treatment; sensitization to heat of spoilage organisms, such as Saccharomyces cerevisiae and spores of Bacillus cereus and Bacillus subtilis by previous radiation treatment; effect of irradiation on changes in the pectic constituents of fruit, like the apple; and the radiation sensitivity of carotenoids in oranges. (auth)

26742 UNITED STATES ATOMIC ENERGY COMMISSION RADIATION PROCESSING OF FOODS PROGRAMME. Fowler, E. E.; Shea, K. G.; Dietz, G. R. (Atomic Energy Commission, Washington, D. C.). pp 655-71 of STI-PUB-127.

The current progress of the United States Atomic Energy Commission's Radiation Processing of Food Program, with emphasis on the clearance of such foods for general human consumption, product development, facility design, process conditions and economics, and commercial aspects are discussed. Semi-production processing for a number of products has now become feasible. The goal is to test laboratory data under near-commercial-scale process conditions, and to obtain cost data. Either completed, or nearing completion, are semi-production facilities capable of processing various foods in quantities of thousands of pounds per hour. Among them are the Marine Products Development Irradiator, the Mobile Gamma Irradiator and the Grain Products Irradiator, for bulk and packaged grain. Plans for a Hawaiian Development Irradiator are also discussed. Activities in the United States, which are related to the commercialization of radiation processing of foods, including the use of radiation for processing fresh fish and fruits, sterilized meats, and other food products, are discussed. For example, a project is under way in which several agencies of the United States Government are attempting to establish a co-operative program with industry, aimed at the development of a pilot-plant meat irradiator. These efforts are directed towards the establishment of a large facility operated by industry which would provide necessary radiation-sterilized meats for the armed services, establish process conditions and economics, and introduce some of the product into the civilian economy for commercial purposes. (auth)

26743 THE UNITED STATES ARMY FOOD IRRADIATION PROGRAMME. Mehrlich, F. P. (Army Natick Labs., Natick, Mass.). pp 673-95 of STI-PUB-127.

The United States Army ten-year food irradiation program is a comprehensive, scientific, and technological effort that has produced sufficient results to warrant the confidence it now enjoys. Modern, highly-effective facilities are now available to expedite all phases of the work. Highly-qualified research personnel have been drawn into the program over the years, and with present fine resources and the talent bank, all aspects of interest, such as sources, doses, radiation effects, and product development, are receiving intensive study. Topics discussed include the scope and essential findings of the United States Army wholesomeness studies; acceptance-testing procedures and typical hedonic ratings; the status of gamma-ray and accelerated electron irradiation. Reference is made to food items cleared by the United States Food and Drug

Administration (FDA); petitions accepted and pending; and special objectives of electron irradiation studies. The influence on product quality of conditions current during irradiation is discussed, with emphasis on nutritive and sensory improvements stemming from low (cryogenic) temperatures and from high dose-rate irradiation. The place of radiation pasteurization in the Army program is described, especially with regard to poultry product improvements achievable by this means. The work on packages and packaging for irradiated foods, now under development, is reported. Studies (and FDA clearances) of rigid containers, parchment liners, and of resinous can linings are reviewed. The promising leads in flex-pack development are of much interest. An important section of the paper concerns the efforts of other Federal Agencies, such as the United States Atomic Energy Commission, the United States Department of Interior, Bureau of Fisheries, and the United States Department of Agriculture. A perspective on the interrelationships of these efforts with the United States Army program is given. Future plans are briefly described. Highlights of the new five-year research and development program are set forth. Of special interest is the industrial food irradiation pilot plant, now in the planning stage. (auth)

26744 IRRADIATION INSTALLATIONS IN FRANCE FOR FOOD IRRADIATION. Leveque, P. (Centre d'Etudes Nucleaires, Saclay, France). pp 697-700 of STI-PUB-127. (In French).

The Centre d'Études Nucléaires de Saclay has a source whose present activity is 6000 Ci. This can be used for food irradiation either for homogeneous irradiation in a cylindrical space of variable dimensions or for panoramic irradiation in a casemate. At the Centre d'Études Nucléaires de Cadarache two sources of 2000 Ci and 12,000 Ci are in operation. One specific use of the latter is to irradiate large quantities of grain with homogeneous doses at high rates (10^6 rad/hr). At Dagneux (near Lyons) the Centre Lyonnais d'Applications Atomiques has an industrial-type plant which can contain up to 2 million curies of ^{60}Co. The source at present has a strength of 80,000 Ci. This installation is of the swimming-pool type, with a conveyer permitting continuous processing of the commodities for treatment. The sources are of variable geometry, so that irradiation can be carried out on a smaller scale. Provisionally based at Saclay, IRMA, owned by the Société Conservatome Industrie, is a mobile irradiation source containing 175,000 Ci of ^{137}Cs. It will allow irradiation of commodities on the production site. (auth)

26745 PILOT PLANT FOR FOOD IRRADIATION IN THE NETHERLANDS. de Zeeuw, D.; van Kooy, J. G. (Association EURATOM-Ital., Wageningen, Netherlands). pp 727-32 of STI-PUB-127.

The main problem raised by pilot plant investigations is to devise a method for bridging the gap between developmental work in the laboratory and the practical applications of this work. These aspects are discussed on the basis of a planned pilot plant for food irradiation in The Netherlands. (auth)

26746 RADIOPASTEURIZATION OF PRODUCE. Maxie, E. C.; Sommer, N. F. (Univ. of California, Davis). New York, American Institute of Chemical Engineers, 1966, Preprint No. 34D, 6p., $0.50. (CONF-660903-4). DTIE.

From American Inst. of Chemical Engineers Meeting, Atlantic City.

Developments in the radiopasteurization of fruits between 1964 and 1966 are summarized. Results are reported from studies on tomatoes, bananas, Bartlett pears, prunes, strawberries, peaches, nectarines, and papayas exposed to various doses of γ radiation. It is pointed out that the physiological state of a fruit is a very critical factor in its response to radiation and that the more nearly a fruit approaches full ripeness, the less harm radiation does to it. The importance of packaging techniques and storage temperature on the extension of the storage life of fruits is also stressed. Combination of heat treatment and γ radiation has proved effective for control of the brown rot organism of Prunus, *Monilinia fructicola*. Radiation treatment has also proved effective for the disinfestation of papayas of the Hawaiian fruit fly. Economic factors affecting the breeding of facilities for the irradiation of fruits are discussed briefly. (C.H.)

METALS, CERAMICS, AND OTHER MATERIALS

Metals and Alloys

26747 (NASA-CR-54358) DEVELOPMENT AND EVALUATION OF MAGNETIC AND ELECTRICAL MATERIALS CAPABLE OF OPERATING IN THE 800° TO 1600°F TEMPERATURE RANGE. Fifth Quarterly Report, December 1, 1965–February 28, 1966. Report No. 66.33E. Kueser, P. E.; (and others) (Westinghouse Electric Corp., Lima, Ohio. Aerospace Electrical Div.). Mar. 1966. Contract NAS3-6465. 263p.

Progress in development of high-temperature magnetic materials with satisfactory strength for use in the solid rotors of electrical generators is reported. Two strengthening mechanisms are being studied to develop better magnetic materials. These are precipitation-hardening at 800 to 1200°F and dispersion strengthening at 1200 to 1600°F. In the precipitation-hardening area, both martensitic alloys and Co-base alloys are being evaluated. The best martensitic alloys which have both adequate strength and magnetic properties have the following basic composition: Fe; Ni, 10 to 15 wt %; and Co, 20 and 30 wt %. Additions to this base composition to obtain hardening include: Ta, 3 to 4 wt %; W, 0 to 2 wt %; Al, 0.5 wt %; and Ti, 0.5 wt %. The Co-type base composition has: Co; Ni, 10 to 15 wt %; and Fe, 5 wt %. Additions to this base composition to achieve the gamma prime hardening include: Al, 1.0 to 1.5 wt %; Ta, 2 to 4 wt %; and Zr, 0.3 wt %. In the early screening phases of the dispersion-strengthened magnetic material program, the composition observed with the highest strength at 1200 to 1600°F was Co + 1.1 wt % B + 4.4 wt % Nb. It was hot extruded from the prealloyed atomized powders. The material was strengthened by the tau ($Cr_{23}C_6$ structure) ternary boride compound. While the dispersion-strengthening of Fe-27% Co-base materials provide better magnetic properties than Co-base materials, the tensile strength of these materials is less than the Co type. Creep testing has continued on Nivco alloy and one sample has achieved 4122 hr at 1100°F and the environmental pressure is 2.6×10^{-9} torr. The applied stress is 37,500 psi and the present elongation is 0.44%. Efforts devoted to determining the feasibility of high-temperature capacitors using high-quality dielectric materials are described. A pyrolytic B_3N capacitor has several orders of magnitude better RC product than teflon, mica, mylar, and vitreous enamel capacitors. It also has shown the best stability represented by the least change in capacitance over the temperature range from room temperature of 1100°F. Incorporation of developments on alkali metal-compatible ceramic-to-metal seals, and combinations of materials fabricated into stators, bore seals, transformers, and solenoids for investigations of compatibility under electrical and magnetic stress at elevated temperatures and under high vacuum is reported. Bend tests on Nb–1Zr joined to BeO ceramics by the active-metal braze, 60Zr–25V–15Nb, retained flexural strengths of greater than 15,000 psi after 500 hr exposure at 1600°F in K. This braze system also has a ductility greater than any other active-metal braze system tested to date as determined by the tab peel tests which are an indication of its notch sensitivity. Testing of stator, transformer, and solenoid test vehicles, which will provide data on the stability of materials applied to typical electrical designs, was continued. No degradation has been noted in either the electrical conductivity of the conductor systems or in the electrical insulation systems selected. The stator has achieved 2032 hr at 1100°F and is operating at an environmental pressure of 1.4×10^{-8} torr. The transformer and solenoid have achieved 1800 hr at 1100°F and are operating at a pressure of 4.8×10^{-8} torr. (auth)

26748 (NP-16743) A FATIGUE APPARATUS FOR USE IN STUDIES OF CRACK PROPAGATION AND DISLOCATION MORPHOLOGY IN FATIGUE. Technical Report No. 3. Wade, Thomas B. (Northwestern Univ., Evanston, Ill. Dept. of Materials Science). Jan. 31, 1967. Contract NONR-1228(32). 81p.

A direct stress hydraulic fatigue apparatus has been constructed for use in a study of fatigue behavior and crack propagation in metals. The loading apparatus provides a static load, either tensile or compressive, of up to 290 pounds with a superimposed cyclic load (tensile and/or compressive) of up to 3350 pounds. The frequency of loading may be varied continuously from 560 cpm to 1250 cpm. Both the magnitude of load and the frequency of loading may be altered at any time during a test. Tests may be conducted in various gaseous and vapor environments as well as in vacuum of up to 10^{-6} torr. Temperature control is not included in the initial design, but may be added easily. Auxiliary equipment has also been constructed for sample preparation and observation of crack propagation. (auth)

26749 THE SWEDISH INSTITUTE FOR METAL RESEARCH. Kiessling, R. (Institutet for Metallforskning, Stockholm). Svensk Kem. Tidskr., 79: 177-85(1967). (In Swedish).

Fundamental research in the materials field is the main task of the Institute but also specific projects of a more applied nature are investigated. A great deal of work is carried out for various research committees set up by the sponsoring societies. The principal fields of study are metal physics, corrosion, analytical chemistry, x-ray metallography and powder metallurgy. The extensive and up-to-date equipment includes optical and electron microscopes, electron probe microanalyzers, spectrographic x-ray fluorescence and gas analytical equipment, a set of vacuum furnaces, electronic tensile testing machines and a central creep laboratory. (Swed)

Corrosion and Erosion

Refer also to abstracts 26766, 26793, and 26811.

26750 (ANL-7241) LABORATORY INVESTIGATIONS IN SUPPORT OF FLUID-BED FLUORIDE VOLATILITY PROCESSES. PART XIV. THE CORROSION OF NICKEL AND NICKEL ALLOYS BY FLUORINE, URANIUM HEXAFLUORIDE, AND SELECTED VOLATILE FISSION PRODUCT FLUORIDES AT 500°C. Gunther, William H.; Steindler, Martin J. (Argonne National Lab., Ill.). Dec. 1966. Contract W-31-109-eng-38. 40p. Dep. CFSTI.

The corrosion of selected materials of construction by fluorides of interest in the Fluoride Volatility Process has been studied. The metals investigated include: Ni-200, Ni-201, Monel, Inconel, Duranickel-301, HyMu-80, INOR-8, and Ni-200 coupons containing areas of Ni-200 weld, Ni-61 weld, or silver solder. Exposures of these metals for periods up to 30 hr at 500°C were carried out in elemental F_2, UF_6, SF_6, and some of the following volatile fission product fluorides, both individually and in the presence of F_2: GeF_4, AsF_5, NbF_5, SbF_5, BrF_5, SeF_6, MoF_6, and TeF_6. Corrosion rates were calculated from both the weight gain of the coupons after exposure and the weight loss of the coupons after descaling in a KNO_3-NaNO_3 bath at 500°C. All of the exposed coupons were examined microscopically for intergranular penetration of the base metal. Nickel-200 and Monel exhibited the best overall resistance to corrosion by F_2, UF_6, and some of the volatile fission product fluorides individually and in the presence of F_2 at 500°C. (auth)

26751 (ANL-7252) STUDIES IN ZIRCONIUM OXIDATION. Levitan, J.; Draley, J. E.; Van Drunen, C. J. (Argonne National Lab., Ill.). Dec. 1966. Contract W-31-109-eng-38. 25p. Dep. CFSTI.

The oxidation of Zr at 550, 700, and 800°C, and at moderate pressures, followed rate laws that were between parabolic and cubic. Resistance measurements generally indicated electronic control of oxidation, although control during initial stages was partly ionic. The electric field across the growing scale exhibited a dependence on the partial pressure of O_2 in the low-pressure range. Gravimetric and volumetric measurements during low-pressure oxidation indicated a different mechanism: initial oxidation was linear, suggesting surface-reaction control. Interpretation in terms of an induction period is also suggested. Zr bearing a vapor-deposited Au film exhibited linear pressure dependence of oxidation for long times at moderate pressures. Measurements of potential and resistance during interaction of Zr with H_2O vapor, CO_2, and N_2 provided indications of the reaction mechanisms. (auth)

26752 (BNWL-SA-1030) NICKEL PLATING URANIUM: REVIEW OF LABORATORY STUDIES. Lundquist, J. R.; Braun, R. L.; Stromatt, R. W. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Jan. 16, 1967. Contract AT(45-1)-1830. 34p. (CONF-670606-2). Dep. CFSTI.

From American Electroplaters Society National Convention, Dallas, Tex.

Electroplating nickel onto uranium is discussed with respect to development of an improved anodic etch for the uranium, a method for determining optimum pickling conditions and the classification of anodic etches, and the evaluation of the nickel plating solution. Anodization of uranium in H_2SO_4–HCl was found to produce a surface on which a nickel coat with good adherence and low pore density can be plated. Several etching techniques are classified by the electrode potential assumed by uranium when immersed in a $NaClO_4$ solution. The uranium potentials are also used to determine optimum pickling conditions for the uranium after the anodic etch. Several plating solutions are evaluated on the basis of their reactivity toward uranium and the adherence and porosity of the plates. (auth)

26753 (ORNL-TM-1834) ELECTROCHEMICAL MEASUREMENTS ON CRYSTAL-BAR ZIRCONIUM IN OXYGENATED 0.05 M K_2SO_4 SOLUTIONS, BETWEEN 200^0 AND 240^{0}C. Gadiyar, H. S. (Oak Ridge National Lab., Tenn.). Apr. 28, 1967. Contract W-7405-eng-26. 42p. Dep. CFSTI.

Electrochemical measurements on crystal-bar Zr in oxygenated 0.05$\underline{M}$ K_2SO_4 solution were made between 200 and 240°C, to measure the rates of corrosion and film growth at different temperatures. The rate-time plots obtained were analyzed for kinetics of film growth. (auth)

26754 (RFP-781) CORROSION OF BORON-STAINLESS STEEL BY NITRIC ACID. Irwin, D. S. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). July 22, 1966. Contract AT(29-1)-1106. 14p. Dep. CFSTI.

A study was made of the corrosion of B-stainless steel by HNO_3 solutions. The rates of B loss due to thickness reduction and leaching of the remaining metal were determined. The data were extrapolated to calculate the useful life of B-stainless steel as a neutron poisoning agent. (auth)

26755 (UJV-1638) KOROZE OCELI VODOU V RADIACNICH PODMINKACH. (Corrosion of Steel by Irradiated Water). Rypar, V.; Zajic, V. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). Nov. 1966. 49p. (In Czech). Dep.

Corrosion of unalloyed steel with low carbon content in water, either in reactor core or outside the core in radiolyzed water was investigated. It has been determined that in both cases a change in the corrosion rate occurs in radioactive medium in comparison with corrosion conditions in an inactive medium. The corrosion effect is ascribed to the radioactive production of H_2O_2 and its decomposition to O_2, which inhibits, together with gaseous water-solved O_2, the corrosion. Tests of the corrosion inhibition of steel in water by introducing H_2 or NH_3 have been carried out. Corrosion rates of steel in water under specified conditions are given. (auth)

26756 METALLIC Zr REACTIONS WITH MOLTEN SODIUM, POTASSIUM, AND CESIUM CHLORIDES. Volodin, V. P.; Smirnov, M. V.; Ozeryanaya, I. N. (Inst. of Electrochemistry, Irkutsk, USSR). Zashch. Metallov, 3: 193-7(Mar.-Apr. 1967). (In Russian).

Measurements of the rate of Zr corrosion in K, Na, and Cs chlorides in an argon atmosphere demonstrated that the corrosion rate increased in the following order: NaCl, KCl, and CsCl. (R.V.J.)

26757 OXIDATION BEHAVIOUR OF SOME NICKEL BASE ALLOYS IN CARBON DIOXIDE AT 900 TO 1000^0. Antill, J. E.; Peakall, K. A.; Warburton, J. R. (Atomic Energy Research Establishment, Harwell, Eng.). Brit. Corros. J., 1: 277-82 (July 1966).

The oxidation behavior of 3 nickel-base alloys, EPE 16, Nimonic 75, and Hastelloy X, was studied in 1 atm of CO_2 at 900°, and in the case of Hastelloy X at 1000°, for maximum exposure of 8000 hr. Weight gain data were obtained and changes in the subsurface of the metal were examined. The structure of the metal could be altered up to a depth of 200 μ by void formation, internal oxidation, and decarburization. Hastelloy X was the most resistant alloy and an aluminized coating greatly increased the resistance of EPE 16. With the exception of one batch of Nimonic 75, the addition of 5 to 10% of CO_2 to the gas did not affect the behavior. The decarburization of the surface of Nimonic 75 in 3×10^{-3} atm of CO_2 was studied at 900° using ^{14}C as a tracer. Carbon was transferred both to the gas phase and to the center of the specimen by the reaction: CO_2 + C (in the metal) → 2CO. After the initial oxidation, the rate of carbon transfer to the gas was 6×10^{-3} $\mu g/cm^2$ hr decreasing to 3×10^{-3} $\mu g/cm^2$ hr at the end of the 1900-hr exposure. Over half the carbon removed from the surface diffused into the center of the specimen. This diffusion was attributed to Cr depletion at the surface to form a Cr-rich oxide, being primarily responsible for the decomposition of the Cr carbide phase in the metal. (BBB)

26758 OXIDATION OF Hf-Ta ALLOYS. Berkowitz-Mattuck, J. B. (Arthur D. Little, Inc., Cambridge, Mass.); Kaufman, L.; Clougherty, E. V.; Hopper, R. Trans. Met. Soc. AIME, 239: 750-3(May 1967).

The oxidation behavior of Hf alloys such as Hf-27 Ta, Hf-20 Ta-2Mo, and Hf-20 Ta-Zr was tested at high temperature in low pressure O_2-He mixtures. Tests were conducted on similar specimens in high-temperature flowing air at atmospheric pressure. Results are presented tabularly. (J.R.D.)

26759 OXIDATION-RESISTANT BERYLLIUM ARTICLES AND PROCESS OF MAKING. (to United States Atomic Energy Commission). British Patent 1,069,250. May 17, 1967. Priority date June 22, 1964, United States.

A coating method to increase the corrosion and oxidation resistance of Be in high-temperature air is described. The process comprises coating the Be with a lacquer slurry containing crushed Be-Si alloy. The coated Be is heat treated at 950 to 1000°C in vacuum then at 1200°C in inert gas. (J.R.D.)

26760 METHOD OF IMPARTING CORROSION RESISTANCE TO ZIRCONIUM BASE ALLOYS. Bertea, Octavian; Seagle, Stanley Robert; Gross, James Richard (to National Distillers and Chemical Corp.). British Patent 1,068,855. May 17, 1967. Filed Oct. 29, 1964.

A method is described for increasing corrosion resistance of Zr-Nb alloys by subjecting the alloy surface to a final cold working step which results in cold work remaining in the final product. (J.R.D.)

26761 CORROSION RESISTANT MATERIALS HANDBOOK, 1966. Mellan, Ibert. Chemical Process Monograph Series. Park Ridge, N. J.; Noyes Development Corp., 1966. 246p. $25.00.

The book is a compilation of 95 tables arranged by type of corrosion resistant material. An extensive double index is organized by corrosive chemical. The tables include information on resins, elastomers, cements and mortars, glass, wood, metals, and alloys. (B.L.M.)

Preparation and Fabrication

Refer also to abstracts 26022 and 27105.

26762 (AECL-2652) THE FABRICATION AND METALLURGICAL EVALUATION OF $3^1/_4$ INS DIAMETER COLD-WORKED ZIRCONIUM-$2^1/_2$ PERCENT NIOBIUM PRESSURE TUBES. Cheadle, B. A.; Evans, W. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Dec. 1966. 43p. Dep. CFSTI. AECL $1.00.

The fabrication and metallurgical evaluation of twelve $3^1/_4$ in. ID cold-worked Zr-$2^1/_2$% Nb pressure tubes are described. Tubes made by extrusion and cold-drawing ~22% were stronger than tubes which were annealed between extrusion and drawing. The ultimate tensile strength (UTS) of the strongest tubes exceeded 70,000 psi at 300°C. Generally, back ends of tubes were stronger than front ends and the transverse strengths were higher than longitudinal ones. These properties are correlated with the textures. A post-fabrication anneal at 400°C for 72 hours had little effect on the UTS of the strongest tubes, but the .2% yield strength decreased by up to 24%. Annealing at 500°C for 10 hours weakened all the tubes. (auth)

26763 (AERE-R-5430) METHOD FOR PREPARING THIN CHROMIUM FOIL. Stephen, J.; Osborne, D. N. (Atomic Energy Research Establishment, Harwell (England)). Mar. 1967. 10p. Dep. CFSTI. UK 1s. 9d.

A method is described for preparing thin Cr foil, less than 12 μ in thickness, by electrolytically depositing the Cr on thin Cu foil, which is subsequently removed. The Cr foil was required for use as the matrix for single-line ^{57}Co sources in Mössbauer studies. (auth)

26764 (BM-RI-6957) ELECTROWINNING HIGH-PURITY NEODYMIUM, PRASEODYMIUM, AND DIDYMIUM METALS FROM THEIR OXIDES. Morrice, E.; Henrie, T. A. (Bureau of Mines, Washington, D. C.). May 1967. 16p.

High-purity Nd, Pr, and didymium (a cerium-free mixture of light rare-earth elements) were prepared by electrolysis of the oxides in a medium consisting of the respective rare-earth fluorides and LiF. The metals were electrodeposited in the liquid state and collected as nodules on a skull of frozen electrolyte. Cells were operated from 1,000 to 1,100°C. The requisite temperature was maintained by passing alternating and direct currents through the bath. Graphite was used for the anodes and W for the cathode. The metal products contained <0.02% each C and O and <0.025% W as major impurities. Analysis of typical didymium metal nodules showed an approximately twofold enrichment in Nd and Pr over their respective concentrations in the cell feed. The La content of the metal was about one-half its content in the oxide. (auth)

26765 (NASA-TN-D-3944) BRAZING TUNGSTEN FOR HIGH-TEMPERATURE NUCLEAR SERVICE IN HYDROGEN. Moore, Thomas J. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center); Japka, Joseph E.; Gordon, Emanuel (United Nuclear Corp., Elmsford, N. Y.). May 1967. 28p. CFSTI.

An investigation was conducted to determine alloys suitable for brazing W for thermal-nuclear-reactor service to 2500°C in a H_2 atmosphere. Braze alloys with melting ranges between 2300 and 3140°C were selected and utilized for the initial melting-range and flow tests in which furnace-brazed lap joints were employed. Localized heating by gas W-arc and electron beam methods were investigated, and the gas W-arc method was selected for effecting straight butt-brazed joints for study. The alloys W−25 wt % Os, W−50 wt % Mo−3 wt % Re, and Mo−5 wt % Os were utilized in the form of fragments (−16/+25 mesh) that were placed along a straight butt joint in 0.020-in. W sheet with an initial gap of 0.010 in. The fragments then were melted by the automatic gas W-arc process in such a manner that the braze metal filled the gap by capillary flow with minimum base-metal dissolution. Eight samples were produced with each of the three selected alloys by preparing butt joints between two 0.020- by $^3/_4$- by 3-in. pieces of W sheet to produce specimens with overall dimensions of 0.020 by $^3/_4$ by 6 in. These specimens were evaluated by nondestructive inspection, tensile tests at 2200°C (both as-brazed and after a 2500°C aging treatment in flowing H_2), and by metallographic techniques. On the basis of the evaluation studies, the joints brazed with the W−25 Os alloy were the most suitable for high-temperature service in H_2. The joints brazed with the W−50 Mo−3 Re and the Mo−5 Os alloys showed less promise under the evaluation criteria applied. (auth)

26766 TWO WAYS TO JOIN WIRE SPACERS TO REACTOR FUEL TUBES. Vandenberg, Stuart R. (General Electric Co., San Jose, Calif.). Metal Progr., 91: No. 6, 67-9(June 1967).

Corrosion resistance and mechanical properties of Hastelloy-X and Incoloy-800 wire spacers attached to fuel tubes by furnace brazing with BNi-5 and -7 filler metal and by resistance projection welding were evaluated. Joints were subjected to mechanical-shear tests, which showed the average weld strength was 124 lb. Bonding was across the interface, and the heat-affected zone in the tube was minimized. In stress-rupture tests at 1300°F in Ar, tubes lasted slightly longer than those without wire spacers, indicating that the wire actually strengthened the tubes. Brazing did not change the dimensions of the tubing. Structurally BNi-5 produced more homogeneous joints than BNi-7, but the latter was preferred because of BNi-5's high brazing temperature and its susceptibility to microcracking and corrosion. Even after 1000-hr exposure to superheated steam at 1270°F, BNi-7 showed no corrosion. Fine porosity did not affect the joint's corrosion resistance nor its mechanical properties. (P.C.S.)

26767 MANUFACTURE OF BERYLLIUM. EQUIPMENT AND METHODS EMPLOYED BY THE ROYAL ORDNANCE FACTORY, CARDIFF. Green, R. E. Machinery, 110: 1072-9 (May 17, 1967).

The equipment and procedures up to the machining stage are described, and information is included on the precautions taken to avoid the possibility of inhalation of Be dust. The metal, received as pebbles or flake, is cast into ingots in a vacuum furnace. Ingots are turned on a lathe to produce swarf, which is converted to powder in an attrition mill. A ball mill is used for experimental batches. Billets and some special shapes are produced from the powder by hot pressing. (UK)

26768 FORGING AND DRAWING ORIENTATIONS OF MOLYBDENUM WIRE OBTAINED FROM SINGLE CRYSTALS OF VARIOUS ORIENTATIONS. Babareko, A. A. Izv. Akad. Nauk SSSR, Metal., No. 1, 140-4(Jan.-Feb. 1967). (In Russian).

Single crystals of Mo with a diameter of 3 to 4 mm, grown by electron-beam vacuum-zone refining without the use of a N_2 trap, were studied. The impurity concentrations were: <0.01 Cu, <0.01 Fe, <0.01 Si, <0.01 Sn, 0.0017 O, and 0.0002 H (in wt %). Single crystals of Mo of this purity take on orientations within a region of 20° about the [110] direction as a result of rotary forging with heating to 400 to 600°C, permitting deformation in subsequent cold drawing. The wire obtained had a polycrystalline structure but retains a "single crystal" orientation. After cold drawing, the wire had an axial orientation $\langle 110 \rangle$ at the center and a cylindrical orientation $\{110\} \langle 011 \rangle$ on the surface. An increase in the reduction in cold drawing reduced the dispersion of the orientation and increased the axial component in the surface layer. (ATD)

26769 LANTHANUM AND CERIUM THERMAL REDUCTION OF YTTERBIUM OXIDE. Gvelesiani, G. G.; Nadiradze, A. A. Izv. Akad. Nauk SSSR, Metal., No. 1, 213-18(Jan.-Feb. 1967). (In Russian).

The vacuum reduction of Yb_2O_3 with La and Ce was investigated. The specimens of cylindrical shape, 15 mm in diameter and 3 mm in length, consisted of compressed powders of Yb_2O_3, Ce, and La, respectively. The experimental results are shown graphically. The experimental data were treated and it was concluded that the reduction of Yb_2O_3 proceeds according to the following scheme: $Yb_2O_{3(s)} + 2\ La_{(1)} = 2\ Yb_{(g)} + La_2O_{3(s)}$ and $Yb_2O_{3(s)} + 2\ Ce_{(1)} = 2\ Yb_{(g)} + Ce_2O_{3(s)}$. (ATD)

26770 RARE EARTH COBALT COMPOUNDS WITH THE AB_3 STRUCTURE. Ostertag, Werner (Air Force Materials Lab., Wright-Patterson Air Force Base, Ohio). Trans. Met. Soc. AIME, 239: 690-4(May 1967).

A series of rare earth Co compounds of the composition RCo_3 (R = Ce, Pr, Nd, Sm, Gd, Tb, Dy, Ho, Er, Tm, Lu) has been prepared. The compounds crystallize in space group R3m and are isomorphous with $PuNi_3$. Except for $CeCo_3$ and $PrCo_3$ the series shows decreasing values of a_0 and c_0. The relatively small parameters of $CeCo_3$ and $PrCo_3$ are explained by valencies of Ce or Pr which exceed the usual rare earth valency of three. The structure of the compounds is discussed as in-fillings of kagomé nets in direct and staggered superposition. (auth)

26771 ON THE ELECTROSLAG WELDING OF ASTM.A 302 B HEAVY STEEL PLATE FOR REACTOR PRESSURE VESSELS. Naiki, Torazo; Kume, Ryoichi (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo). Ishikawajima-Harima Giho, 6: 493-507(Nov. 1966). (In Japanese).

Electroslag welding requires special considerations to cover the detrimental effect of large heat input and slow cooling rate on the mechanical properties, especially notch toughness, of welded joints. Good notch toughness requires heat treatment after welding. Suitable conditions for heat treatment of electroslag welded joints of ASTM • A 302 B steel for reactor pressure vessels have been determined by studies on the relationship between notch toughness and cooling rate, and between cooling rate and plate thickness. The conditions thus determined were confirmed through tension, side bend, V-notch Charpy impact, and hardness tests as well as through observation of the micro-structure. (NSA Japan)

26772 APPLICATION OF ELECTRON BEAM FURNACE TO TUNGSTEN AND MOLYBDENUM ZONE MELTING. Shroff, A.-M.; Borromee, C. (Compagnie Generale de Telegraphie Sans Fil, Orsay, France). Rev. Int. Hautes Temp. Refract., 3: 385-93(Oct.-Dec. 1966). (In French).

Electron beam zone melting of Mo and W under a vacuum of 10^{-5} torr gave a product largely monocrystalline in which impurities, gaseous or solid were greatly diminished. Low-temperature mechanical and electrical properties were improved. Application of this technique is considered to be of particular interest in electronics and in research on emitters. (P.G.C.)

26773 APPLICATION OF ELECTRON-BEAM FURNACE TO METALLURGICAL ELABORATION PROBLEMS. Gosse, G.; Lehr, P.; Albert, Ph. (CNRS, Vitry-sur-Seine, France). Rev. Int. Hautes Temp. Refract., 3: 371-84(Oct.-Dec. 1966). (In French).

The oxides of Zr and Hf were reduced to the corresponding metals in an electron beam furnace at 2500 to 3500°K under vacuum of 10^{-6} to 10^{-4} torr. Reducing agents were C, Si, and Al, all of high purity. It was determined, by gas analysis that O was removed in the form of gaseous sub-oxides corresponding to the type of reductant used, Co, SiO, or Al_2O. Hf produced by this method had a purity of 99.7%. (P.G.C.)

26774 METALLOGRAPHIC TECHNIQUE FOR LANTHANUM AND CERIUM. Koch, C. C.; Picklesimer, M. L. (Oak Ridge National Lab., Tenn.). Trans. Met. Soc. AIME, 239: 759-61(May 1967). (ORNL-P-2788).

A preparation technique is described that clearly reveals the microstructure of these metals and preserves their etched surfaces for days. The specimens are chemically polished at room temperature providing an anodic film which protects the surface from the atmosphere. Colors produced in the film are the basis of a technique for phase identification. (J.R.D.)

26775 DEVELOPMENT OF ROLLED JOINTS FOR THE HWOCR. Zalenski, R. F.; Mordarski, W. J. (Combustion Engineering, Inc., Windsor, Conn.). Contract AT(38-1)-430. Nucl. Eng. Design, 5: 76-80(Jan.-Feb. 1967).

The heavy water moderated-organic cooled pressure tube reactor, HWOCR, uses SAP 895 alloy tubing in the reactor core and carbon steel ex-reactor piping. The critical item of the reactor structure is the transition between the SAP-tubing and the ex-reactor piping. Design and fabrication development with the objective of producing rolled joints between the pressure tubes and ex-reactor piping which will withstand typical reactor operation temperature levels and fluctuations over the service life of the HWOCR are described. (auth)

26776 REINFORCEMENT OF NICKEL WITH SOME HIGH-STRENGTH FILAMENTS. Ahmad, Iqbal; Greco, V. P.; Barranco, J. M. (Army Watervliet Arsenal, Watervliet, N. Y.). J. Compos. Mater., 1: 18-29(Jan. 1967).

Composites of Ni containing W and $\alpha-Al_2O_3$ whiskers were formed by the electroforming process. Yield and tensile tests were performed; results are given. Use of the electroforming technique is also proven as feasible for the production of a Ni composite reinforced with B and E-glass filaments and SiC whiskers. (M.L.S.)

26777 PRODUCTION OF ACTINIDE ALUMINIDE IN A FLUIDIZED BED. Grimmett, Earl S. (to U. S. Atomic Energy Commission). U. S. Patent 3,318,670. May 9, 1967.

A method was developed for making an actinide aluminide by depositing an actinide oxide coating on an Al substrate, converting the oxide to a chloride, and heating until the Al substrate and the actinide chloride react to form the desired actinide aluminide. (auth)

26778 AUSTENITIC STAINLESS STEEL ALLOY. (to The Carpenter Steel Co.). British Patent 1,056,938. Feb. 1, 1967. Priority date Sept. 15, 1964, United States.

Additions of rare earth elements, Gd, Eu, Sm, and Dy, to an austenitic stainless steel resulted in an alloy having an improved absorption cross-section for thermal neutrons. Maintenance of ferrite content at 5 to 25% resulted in good hot-workability. Other alloying agents, Cu, Ti, Mn, S, and P may be added to give improved machinability or corrosion resistance. Suggested uses for the alloy include parts for nuclear reactor control rods. (P.G.C.)

26779 METHOD OF ETCHING TANTALUM AND NIOBIUM FOR ELECTROPLATING. Seegmiller, Robert; Gore, James K. (to U. S. Atomic Energy Commission). U. S. Patent 3,314,867. Apr. 18, 1967.

An etching process for preparing Ta and Nb metal surfaces for electrodeposition of another metal is described. Etching is conducted in an electrolytic bath of absolute methyl alcohol containing about 2.5 vol% each of concentrated Hf and HCl. (P.G.C.)

26780 METHOD FOR PRODUCING TUBE SHELLS. McDonald, R. E.; Leitten, C. F. Jr. (to U. S. Atomic Energy Commission). U. S. Patent 3,314,143. Apr. 18, 1967.

A method for fabricating metal tubing comprises deforming at room temperature a cast, hollow billet on a mandrel to displace the metal uniformly along the mandrel in a direction opposite to the direction of applied force and drawing the resulting tube shell into metal tubing. Metals such as Zr, Ta, Nb, Re, and their alloys, are included. (AEC)

26781 BRAZING ALLOYS FOR TUNGSTEN, MOLYBDENUM AND ALLOYS THEREOF. (to Atomic Energy Commission). British Patent 1,063,274. Mar. 30, 1967. Priority date June 25, 1964, United States.

An alloy consisting of 40 to 87 wt % Mo, 5 to 40 wt % Ru, and 8 to 55 wt % Re was developed for joining Mo, W, and their alloys at a brazing temperature of 1950 to 2500°C under non-oxidizing conditions. (P.G.C.)

26782 METHOD FOR PRODUCING LEAD ALLOY SHIELDING BRICKS. Awau, Sensaburo; Kawabata, Rokuro (to Kimura Entetsu Kagaku Kikai Co., Ltd.). Japanese Patent 1966-6563. Apr. 13, 1966. Filed Oct. 8, 1963.

An improved method is proposed for producing lead alloy shielding bricks. These bricks are usually produced by casting or extrusion, but in casting, voids occur due to solidification, shrinkage, or entrained oxide, resulting in poor shielding properties. By the method proposed these drawbacks are eliminated. A Pb–Sb alloy, containing 1 ~ 8 wt % Sb, is pressed in a mold at 20 ~ 1000 kg/cm^2 in the temperature range from the solidus to the liquidus line, producing the brick. (NSA Japan)

26783 REFRACTORY METAL BRAZING PRODUCT AND PROCESS. Marshall, J. C.; McGurty, J. A.; Korton, G. (to U. S. Atomic Energy Commission). U. S. Patent 3,316,069. Apr. 25, 1967.

A brazing alloy for joining W, Ta, Mo, Nb, and their alloys is described. The brazing alloy consists of 4 to 50 wt % V, 20 to 96 wt % Nb, and 0 to 60 wt % Ta. (AEC)

26784 BRAZING ALLOYS FOR TUNGSTEN AND MOLYBDENUM. Marshall, J. C.; Smith, H. G. (to U. S. Atomic Energy Commission). U. S. Patent 3,312,539. Apr. 4, 1967.

A brazing alloy consisting of 42 to 95 wt % of Mo, 0 to 45 wt % of Re, and 5 to 44 wt % of Rh is described joining W, Mo, and their alloys at 1900 to 2500°C. (P.G.C.)

26785 PHOSPHIDE COATING ON REFRACTORY METALS. Wilhelm, Harley A.; Witte, James H. (to U. S. Atomic Energy Commission). U. S. Patent 3,318,246. May 9, 1967.

A method is described for the manufacture of an article comprising a shaped body of Ta, Nb, W, and alloys consisting predominantly of these metals and for forming an in situ coating of a phosphide of the metal on the article. (AEC)

26786 BRAZING ALLOYS FOR TANTALUM. Mueller, R. H.; Marshall, J. C. (to U. S. Atomic Energy Commission). U. S. Patent 3,309,180. Mar. 14, 1967.

A composite body is described, which consists of at least two members selected from the group consisting of Ta and alloys containing a predominant portion of Ta joined to one another by a brazing alloy selected from a 0 to 90 wt % Ta, 0 to 50 wt % Hf, and the balance Nb. The joint formed from the members and brazing alloy is characterized by a remelt temperature higher than the melting temperature of the selected brazing alloy. (AEC)

26787 BRAZING ALLOY AND METHOD OF BRAZING WITH SAME. Sama, L.; Pepino, G. T. Jr. (to U. S. Atomic Energy Commission). U. S. Patent 3,309,767. Mar. 21, 1967.

An alloy for brazing Nb and Nb alloys and a method of using the alloy were developed. The alloy consists of a finely divided alloy of Ti and 5 to 12 wt % Si suspended in a liquid nitrocellulose carrier. In use the braze alloy is applied to the surfaces to be brazed, following which the coated surfaces are heated to a temperature of approximately 2700°F in a nonoxidizing atmosphere for approximately 10 min and thereafter permitted to cool. (AEC)

26788 METHOD FOR MAKING POROUS TARGET PELLETS FOR A NUCLEAR REACTOR. Lotts, Adolphus L.; Barton, E. E. Jr. (to U. S. Atomic Energy Commission). U. S. Patent 3,324,540. June 13, 1967.

A method is described of making a target pellet having porous metal end closures for use in nuclear reactors. The method consists of cold-pressing within a tubular metal sleeve a three-layer powder compact, the inner layer of which contains an actinide oxide and the outer layers of which consist essentially of metal powder. (AEC)

26789 POROUS TUNGSTEN METAL SHAPES. Hodge, E. S.; Peterson, J. H. (to U. S. Atomic Energy Commission). U. S. Patent 3,328,139. June 27, 1967.

A porous W metal shape is described consisting essentially of a total void volume and a matrix or network of substantially uniform sized, discrete, polyhedral-shaped W metal particles metallurgically bonded at areas of particle contact to provide a density of about 70 to 95% of the theoretical density of W to metal. (AEC)

Properties Evaluations

Refer also to abstract 26861.

26790 (AECL-2847) PROPAGATION OF CRACKS OF FINITE WIDTH. Piggott, M. R. (Atomic Energy of Canada Ltd., Chalk River (Ontario); Chalk River Nuclear Labs.). Jan. 1967. 25p. Dep. CFSTI. AECL $1.00.

In most materials, and especially metals, plastic flow occurs at a stress well below the theoretical strength. Cracks in a stressed material can therefore always be expected to have a finite width. An attempt was made to develop a theory for the propagation of such cracks in an ideal elastic-plastic material. The analysis indicates that cracks that are very much longer than the critical length can be stable, and that in all materials there is a stress below which cracks of any length can be present without the material failing. However, the observed relation between failure strength and crack length in metals can only be explained if it is assumed that the plastic work done when an infinitely thin crack is propagated is proportional to crack length and independent of applied stress. A criterion for brittleness was derived, which accords well with the common observation that hard materials are usually brittle. (auth)

26791 (BNWL-SA-902) PRACTICAL TECHNIQUE FOR OBTAINING AND USING PLASTIC ANISOTROPY INFORMATION. Ireland, D. R. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Feb. 1967. Contract AT(45-1)-1830. 54p. (CONF-670206-4). Dep. CFSTI.

From 96th Annual Meeting of the American Institute of Mining, Metallurgical, and Petroleum Engineers, Los Angeles, Calif.

The Knoop microhardness test can be applied to studies of texture strengthening in Ti alloys. A Knoop Hardness Number (KHN) is empirically assumed to represent a stress deviation. It is also assumed that the direction of the stress deviator is determined by the orientation of the impression relative to the principal axes of anisotropy. This assumption is the basis for using KHN values to construct a closed curve representing the shape of a flow surface. Previous studies have demonstrated the utility of the microhardness flow surface technique for investigations of Zr alloys. An investigation of applying the technique to Ti alloy studies is described. (auth)

26792 (GAMD-5878) THE CREEP AND RUPTURE STRENGTH OF SILICON-ALUMINUM DEOXIDIZED 1 PERCENT CHROMIUM-1/2 PERCENT MOLYBDENUM STEEL AT 1000^{0}F. Wunderlich, J. W. (General Dynamics Corp., San Diego, Calif. General Atomic Div.). Nov. 12, 1964. Contract AT(04-3)-187. 11p. Dep. CFSTI.

The effects of Si–Al deoxidation on the mechanical properties of 1% Cr–½% Mo steel used in pressure vessel for the Experimental Beryllium Oxide Reactor (EBOR) were studied. No significant changes appeared in the creep strength; however, rupture strength was significantly lower at 1000, 10,000, and 100,000 hr than previously reported. It is believed that the information developed in these tests can be used in EBOR to establish a working pressure for the 1000°F operating condition. (P.C.S.)

26793 (IITRI-578-P29-11) RESEARCH ON ZIRCALOY BRAZE ALLOY DEVELOPMENT. [Quarterly Report], January 1, 1967–March 31, 1967. (IIT Research Inst., Chicago, Ill.). Apr. 17, 1967. Contract AT(11-1)-578. 15p. (EURAEC-1841). Dep. CFSTI.

Work Performed under United States–Euratom Joint Research and Development Program.

Brazing and corrosion test results are reported for 68 candidate braze alloys. A significant number of these are promising for brazing Zircaloy-clad fuel elements for pressurized water reactor application on the basis of the autoclave screening test results and some potentially promising on the basis of metallographic examination. Indications from metallographic analysis are that many of the promising systems, and some marginal ones, can be improved by appropriate thermal treatments during brazing or compositional modifications. (auth)

26794 (INR-768/XIV/PS) ODKSZTALCENIA PLASTYCZNE STOPOW Al Ni Fe WSKUTEK CYKLICZNYCH ZMIAN TEMPERATURY. (The Plastic Deformation of Al–Ni–Fe Alloys on Thermal Cycling). Seyna, Feliks (Institute of Nuclear Research, Warsaw (Poland)). Dec. 1966. 24p. (In Polish). Dep.

Two Al–Ni–Fe alloys were tested by three different temperature cycles. The influence of the rolling texture on the deformation value in the mean directions was evaluated. There was found a small resistance to thermal cycles in comparison with aluminum. (auth)

26795 (INR-770/XIV/PS) ZMIANY WLASNOSCI STALI NIERDZEWNEJ 1H18N9T STARZONEJ W WARUNKACH TEMPERATUROWYCH REAKTOROW ENERGETYCZNYCH. CZESC I. ZMIANY WLASNOSCI MECHANICZNYCH. (The Properties of Stainless Steel 1H18N9T After Aging in the Power Reactor Temperature Ranges. Part I. Mechanical Properties). Seyna, F.; Chyczewski, M. (Institute of Nuclear Research, Warsaw (Poland)). Dec. 1966. 26p. (In Polish). Dep.

The effects of aging temperature on the mechanical properties of RO2, Rm, A_{10}, and HV types of water-quenched 1H18N9T stainless steel cold-rolled to various reduction percentages were investigated. No significant property changes were found at 300 to 400°C, but marked changes were found at 500 to 600°C. The mechanical property changes are related to the degree of deformation. (J.R.D.)

26796 (IS-T-152) AC SUSCEPTIBILITY OF LANTHANUM RARE EARTH ALLOYS. Prevender, Thomas Stephen (Ames Lab., Iowa). Feb. 1967. Contract W-7405-eng-82. 57p. Dep. CFSTI.

Thesis.

An ac mutual inductance technique was used to measure the differential susceptibility of La–rare earth alloys in the temperature range to 1 to 20°K. It was found that the La–Gd alloys had anomalously large susceptibilities which, at their peaks, were approximately five times as large as the susceptibility as calculated from the Brillouin function. All alloys studied (La-96–Gd-04, La-94–Gd-06, La-96–Tb-04, La-94–Tb-06, La-96–Dy-04, La-94–Dy-06) showed magnetic ordering as evidenced by a peak in their χ vs. T curves, but the ordering temperatures were lower than those that have been found for other rare earth hosts. (auth)

26797 (NASA-CR-72185) GENERATION OF LONG TIME CREEP DATA OF REFRACTORY ALLOYS AT ELEVATED TEMPERATURES. Quarterly Report No. 14, October 26, 1966–December 26, 1966. Sawyer, J. C.; Steigerwald, E. A. (TRW Equipment Labs., Cleveland, Ohio. Materials Research and Development Dept.). Jan. 17, 1967. Contract NAS 3-2545. 133p.

High-temperature creep data for T-111, TZC, TZM alloys are presented along with similar data on W and W alloys. (J.R.D.)

26798 (NASA-CR-72241) ELEVATED TEMPERATURE FATIGUE OF TZC MOLYBDENUM ALLOY UNDER HIGH FREQUENCY AND HIGH VACUUM CONDITIONS. Topical Report No. 1. Honeycutt, C. R.; Martin, T. F.; Sawyer, J. C.; Steigerwald, E. A. (TRW Equipment Labs., Cleveland, Ohio. Materials Research and Development Dept.). May 1967. Contract NAS 3-6010. 28p. CFSTI.

High frequency fatigue tests were conducted in a high-vacuum environment on recrystallized Mo-base alloy TZC at 1800 to 2200°F. The results indicated that in this temperature range no well-defined endurance limit existed. Fatigue strengths at 2200°F and 10^9 cycles were as low as 16,000 psi. The application of a cyclic load to a statistically loaded specimen produced a marked acceleration in the degree of specimen extension. This increase was characterized by a relatively rapid extension during the first thirty minutes of testing followed by a period of steady state creep which was approximately two orders of magnitude greater than the creep rate observed under a comparable static peak stress. (auth)

26799 (NASA-TN-D-3955) FRICTION CHARACTERISTICS OF SINGLE-CRYSTAL AND POLYCRYSTALLINE RHENIUM IN VACUUM (10^{-11} TORR). Buckley, Donald H. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). May 1967. 16p.

An investigation was conducted in vacuum to determine the friction characteristics of Re in its single-crystal and polycrystalline forms. Experiments were conducted with a hemispherical rider sliding on a flat disk at 0.001 to 700 cm/sec at ambient pressures to 10^{-11} torr. Polycrystalline Re was examined sliding on itself at temperatures to 680°C and loads to 2500. Single-crystal experiments were conducted at 20°C for loads to 1000 g with the basal (001) plane sliding in the $[11\bar{2}0]$ and $[10\bar{1}0]$ directions and the prismatic plane $(10\bar{1}0)$ sliding in the $[11\bar{2}0]$ and [0001] directions on polycrystalline Re. Results of the investigation indicate that the friction characteristics of Re are dependent on its anisotropic nature. Friction data for rhenium correlate with the relation established for lattice parameters and the friction coefficients of hexagonal metals. The marked work-hardening characteristics of Re influenced both single-crystal and polycrystalline friction. (auth)

26800 (NP-16704) STUDIES ON THE HIGH TEMPERATURE OXIDATION OF MOLYBDENUM, TUNGSTEN, NIOBIUM, TANTALUM, TITANIUM, AND ZIRCONIUM. Final Report. Gulbransen, E. A.; Andrew, K. F.; Brassart, F. A. (Westinghouse Research Labs., Pittsburgh, Pa.). Apr. 18, 1967. Contract DA-31-124-ARO-D-196. 63p.

Developments are reported for studies on: vacuum microbalance analysis of fast gas–metal reactions; oxidation of Re and Re–Ti alloy at O_2 pressure of 1 to 10 torr and 800 to 1400°C in flow environments; oxidation of Mo in flow environments at temperatures of 900 to 1600°C and O_2 pressures of 9×10^{-3} to 49 torr; thermochemical analysis on oxidation of Mo; and high voltage electron diffraction apparatus for measuring oxidation reactions at pressure, temperature, and under flow conditions. (P.C.H.)

26801 (NRL-6489) HIGH-TEMPERATURE VACUUM FATIGUE TESTING OF TYPE 316 STAINLESS STEEL AND INCONEL X WITH A RESONANCE-TYPE MACHINE. Smith, H. H.; Shahinian, P.; Achter, M. R. (Naval Research Lab., Washington, D. C.). Mar. 27, 1967. 14p.

A new resonance-type flexural fatigue machine has been used to test Inconel X, a low damping capacity material, and Type-316 stainless steel, a high damping material, at 500 and 800°C. A comparison was made of the reproducibility of the data obtained by various test procedures with smooth and notched specimens. Observations were made of the type of cracking in these materials. The progression of cracking appeared to be reflected in resonant frequency changes during the test. The reproducibility of the fatigue data, in particular of the Inconel X, which has a sharp resonance, is sufficiently good to permit distinguishing environmental effects, the main purpose for which the equipment was designed. (auth)

26802 (UCRL-17449) THE LOW TEMPERATURE THERMALLY ACTIVATED DEFORMATION MECHANISMS FOR BCC MAGNESIUM–LITHIUM–ALUMINUM ALLOY. Abo-el-Fotch, Mohamed Osama (California Univ., Berkeley. Lawrence Radiation Lab.). Mar. 1967. Contract W-7405-eng-48. 38p. Dep. CFSTI.

Thesis.

The effect of strain rate and temperature on the flow stress was investigated in a polycrystalline Mg–14 Li–1.5 Al (wt %) alloy. Whereas the flow stress increased only slightly as the temperature was decreased from room temperature to about 115°K, a rapid increase in the flow stress was obtained with yet greater decreases in temperature from about 115 to 20°K. The strong temperature and strain rate dependence of the flow stress below 115°K was interpreted in terms of the Dorn-Rajnak theory of the Peierls mechanism when the deformation is controlled by the rate of nucleation of pairs of kinks. Above 115°K, an athermal mechanism is operative. (auth)

26803 (UCRL-70323) FRACTURE ANALYSIS BY USE OF ACOUSTIC EMISSION. Dunegan, H. L.; Harris, D. O.; Tatro, C. A. (California Univ., Livermore. Lawrence Radiation Lab.). Feb. 6, 1967. Contract W-7405-eng-48. 60p. (CONF-670604-1). Dep. CFSTI.

From National Symposium on Fracture Mechanics, Bethlehem, Pa.

Results of acoustic emission studies on flawed and unflawed specimens of Al and Be are presented. Acoustic emission from the flawed specimens was found to begin at stress levels far below the general yield stress. A theoretical model given indicates that the total number of acoustic emission signals from a specimen containing a crack should be proportional to the fourth power of the stress intensity factor obtained from a sharp-crack fracture mechanics analysis. This is in disagreement with experimental data from single-edge-notched fracture toughness specimens of the two materials, which indicate that acoustic emission varies more like the sixth to eighth power of the stress intensity factor. An example is given to show how the acoustic emission data obtained on fracture toughness specimens can be used to nondestructively test the fracture strength of an engineering structure. (auth)

26804 (WAPD-TM-505) FRACTURE MECHANICS: A BASIS FOR BRITTLE FRACTURE PREVENTION. Johnson, R. E. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Nov. 1965. Contract AT(11-1)-Gen-14. 90p. Dep. CFSTI.

The development of fracture mechanics is presented both historically and mathematically. The central problems and limitations of experimental fracture mechanics are detailed along with the assumptions and approximations used. The meaning, measurement, and utility of plane strain fracture toughness (critical strain energy release rate or critical stress intensity factor) are discussed. The role of defects in components is discussed specifically with respect to the relationships between stress fields, defect geometry, and material condition. Basic aspects of ultrasonic testing are discussed with respect to quantitative measurement of defect geometries in structures. Selected experiments dealing with application of fracture mechanics to predict actual component failures are reviewed. It is shown that the relationships between stress state, defect geometry, elastic constants, and fracture toughness employed in applied fracture mechanics can be utilized to predict brittle failure conditions in a more quantitative manner than transition temperature concepts. (auth)

26805 (NP-tr-1533) ELECTRICAL RESISTIVITY OF SILVER, COPPER, ALUMINIUM, ZINC, AND SODIUM BETWEEN 4^0 AND 298^0K AS A FUNCTION OF THE IMPURITY CONTENT. Pawlek, F.; Rogalla, D. Translated for Culham Lab., UKAEA, Abingdon, Eng., from Metall, 20: 949-56(Sept. 1966). 21p. (CTO-368). DTIE.

26806 (SLAC-Trans-61) INVESTIGATION OF AUTODIFFUSION IN TUNGSTEN. Danneberg, W. Translated for Stanford Linear Accelerator Center, Calif., from Metall, 15: 977-81(1961). 15p. Dep. CFSTI. JCL \$1.60 fs, \$0.80 mf.

Autodiffusion in W was measured on wire-shaped samples 0.2 mm dia at 2,000 to 2700°C. ^{185}W was used as an indicator. Measurements were supplemented with creep experiments conducted on slightly stressed W wires from which the autodiffusion coefficient was determined at 2,600 and 2,700°K. Results of both methods agreed. The temperature functional relation of the diffusion coefficient is given by the equation $D = 0.54\ e^{(120.5/RT)}$ [cm^2/sec]. Results agree with the theory established by Buffington and Cohen based on a vacancy mechanism. (auth)

26807 NOMOGRAPH FOR DENSITY OF POWDER COMPACTS. Blickensderfer, Robert (Bureau of Mines, Albany, Oreg.). Amer. Ceram. Soc. Bull., 46: 544-5(May 1967).

A nomograph, which gives relations among cross sectional area, density, mass, length, and percent density of thirty ceramic and metallic powder compacts, is presented. It is especially useful for relating the length of a compact to its percent density during the progress of hot pressing. (J.G.B.)

26808 SPECIFIC SURFACE AREA BY LOW-PRESSURE PERMEAMETRY. Orr, Clyde Jr. (Georgia Inst. of Tech., Atlanta). Anal. Chem., 39: 834-6(June 1967).

A flow apparatus and a technique of operation at progressively lower pressures were used to evaluate the relative size parameters of powders by permeametry. The results were in close agreement with low temperature gas adsorption values for the same material. The analysis is based on the equation: $s_\omega = (24/13)\sqrt{(2/\pi)}\ (\epsilon^2/\rho Q\sqrt{MRT})\ (\Delta P/L)$, derived in part by applying a statistical treatment to describe the motion of a free molecule passing through a random pore space. Nomenclature is defined at the end of the article. (J.G.B.)

26809 BERYLLIUM WIRE: A NEW ENGINEERING MATERIAL. Pinto, Norman P.; Denny, John P. (Beryllium Corp., Reading, Pa.). Metal Progr., 91: No. 6, 107-8; 110; 112; 114; 118(June 1967).

A review of the properties and uses of Be wire is given as costs dropped from \$3.00 to 15¢ per foot. Advantages of Be-wire composites with B, Ti, stainless steel, Al, and Ni are discussed. The mechanical and physical properties of the wire are adequate for most applications. (P.C.S.)

26810 STRESS ANALYSIS OF TAPERED TRANSITION JOINT IN REACTOR PRESSURE VESSEL. Hamada, Kunio; Hayashi, Tsutomu (Hitachi, Ltd., Tokyo). Hitachi Hyoron, 48: No. 7, 10-14(July 1966). (In Japanese).

The code "TROIKA" was prepared for stress analysis of tapered transition joints in a reactor pressure vessel. The results of calculation, using the code, agreed well with experimental values obtained in the United States, and showed sufficiently its practicability. Studies were made for the case where two cylindrical shells, or a cylindrical and a spherical shell, were joined through a tapered joint. It was found that by changing the taper shape, the stress distribution is greatly varied, and that although the ASME (etc.) provisions for tapered joints are satisfactory, some points still remain for further study. (NSA of Japan)

26811 BEHAVIOR OF ULTRATHIN ZIRCONIUM FILMS UPON EXPOSURE TO OXYGEN. Fehlner, Francis P. (Corning Glass Works, Corning, N. Y.). J. Appl. Phys., 38: 2223-31(Apr. 1967).

Discontinuous films of Zr, having surface resistivities between 10^4 and 10^6 Ω sq^{-1}, were deposited on glass substrates in ultrahigh vacuum and then exposed to O_2 pressures in the range of 5×10^{-7} to 4×10^{-8} Torr at 25 and −196°C. The change in film resistance with time was monitored and a plot of log R vs log t was constructed. This graph was initially concave upwards, but became linear after a time characteristic of monolayer formation. An interpretation of the film behavior was based on the transport of electrons by tunneling through gaps separating the metal islands. The initial change in film resistance was caused by an increase in the Zr work function. This increase was due to O_2 monolayer formation. The subsequent linear log–log behavior was caused by an increase in the tunneling distance, which resulted from oxidation of the metal islands. Values for both the interisland spacing and the room-temperature oxidation rate constant have been calculated from the experimental data. Both impurities and the heat of adsorption interfered with determining a value for the interisland spacing, but when these interferences were eliminated, a distance of 6.9 Å was found for a 10^4 Ω sq^{-1} film. The oxidation rate constant for a comparable film at 25°C was 4×10^{-9} cm with an activation energy of 0.3 kcal mole^{-1}. Pumping speeds also were determined. Zr initially pumped O_2 at ≈1500 ml sec^{-1} cm^{-2}. The sticking coefficient for O_2 on a partially O_2-covered Zr surface was approximately 0.05. (auth)

26812 GRAIN GROWTH DURING SINTERING OF TUNGSTEN. Kothari, N. C. (Univ. of Queensland, Brisbane, Australia). J. Appl. Phys., 38: 2395-6(Apr. 1967).

Grain growth kinetics during isothermal sintering of W at 1100 to 1650°C for periods of 30 to 500 min were studied. Grain growth was negligible for temperatures below 1400°C and could not be measured precisely. The grain size increased with temperature to a value of 11.0 μ at 1650°C after 500 min. The activation energy for the growth process was calculated to be 94 ± 2 kcal/mole. (A.G.W.)

26813 ELECTRICAL RESISTIVITY OF SmAg, SmCu, AND SmAu. Chao, C. C.; Duwez, P. (California Inst. of Tech., Pasadena). J. Appl. Phys., 38: 2365-7(Apr. 1967).

The electrical resistivity of equiatomic phases of Sm with Cu, Ag and Au was measured down to 4.2°K. Anomalies were found at 10°K for SmCu and at 42°K for SmAg. The resistivity–temperature curve of SmAu has a maximum at 40°K and a minimum at 53.5°K. (auth)

26814 FISSIOGRAPHY: DIFFUSION OF URANIUM IN ALMOST INFINITE DILUTION IN TITANIUM AND IRON. De Keroulas, F.; Mory, J.; Quere, Y. (CEN, Fontenay-aux-Roses, France). J. Nucl. Mater., 22: 276-84(1967). (In French).

A method is described for examining uranium concentrations in metals 10^4–10^5 times smaller than can be detected by autoradiography of ^{234}U. The method depends on recording fission fragments in dielectrics. The method was applied to the study of the diffusion of U (in atomic concentrations of 10^{-7}–10^{-8}) in β Ti and in γ Fe. The diffusion constants obey the equation. (auth)

26815 THERMAL CONDUCTIVITY OF URANIUM DIOXIDE AT VERY HIGH TEMPERATURE GRADIENTS. Patrassi, E. (Kernforschungszentrum, Karlsruhe, Ger.). J. Nucl. Mater., 22: 311-19(1967). (In German).

A method was developed that permitted the measurement of the thermal conductivity of UO_2 over a large temperature range (300°C < T < 2000°C) with variable, controlled temperature gradients (30°C/cm < dT/dx < 5000°C/cm). The accuracy was a function of the temperature and temperature gradient varying between ±3 to ±8%. The measurements show that the thermal conductivity of UO_2, K, is a function of the temperature and the temperature gradient. The dependence is reversible as long as a specimen develops no cracks. The change in elastic properties which result from the thermal stresses produced in a thermal gradient may be responsible for this behavior. Large thermal gradients can also be expected to disturb the uniformity of lattice vibrations. The thermal conductivity exhibits a maximum at 1050°C. Large temperature gradients can also be responsible for this phenomenon. It is possible to correlate this result with the zero point of the Seebeck coefficient, as measured by other experimenters, since the electronic contribution to the thermal conductivity can exhibit a maximum in this temperature range. Measurements made in the high-temperature region ($1200°C < T < 2000°C$) with large temperature gradients (5000°C/cm) show agreement with conductivity values measured in-pile. In this connection, the specimens employed exhibit columnar grains similar to those which appear in irradiated samples. This indicates that it is possible to simulate certain in-pile thermal conditions by this technique. (auth)

26816 CREEP STRENGTH OF URANIUM CONTAINING SMALL ALLOYING ADDITIONS. Slattery, G. F.; Miller, W. N. (United Kingdom Atomic Energy Authority, Salwick, Eng.). J. Nucl. Mater., 22: 320-31(1967).

Sagging bar tests have been carried out on U and U containing low alloying additions of Mo, V, Zr, Cr, Al and Ti. They were designed as comparative sorting tests for the development of dilute U alloys with improved creep strength. The tests have shown no significant difference in the creep strength of adjusted Mg-reduced U which has been subjected to various quenching and annealing treatments. Adjustments of Fe and Al to different levels also produced no observable difference in creep strength in tests of 2500 hr duration. Additions of Mo, V, Al, and Ti enhanced the creep strength whilst additions of Zr and Cr lowered the creep strength. Additions of Ti and Mo to the U–Cr alloy resulted in an improvement in creep particles. Values of the creep moduli, deflection rate and maximum strain rate have been derived. The creep strengths have also been compared by a statistical treatment involving the construction of scatter bands. This method is considered to be the most satisfactory for making comparisons. (auth)

26817 MICROHARDNESS OF PLUTONIUM–GALLIUM ALLOYS. Hays, D. D. (Battelle-Northwest, Richland, Wash.). Contract AT(45-1)-1830. J. Nucl. Mater., 22: 352-5(1967).

The effect of indenting load and surface preparation on the hardness of homogenized Pu-0.78, 0.99 and 1.27% Ga alloys has been determined. These two parameters can combine to cause a hardness variation of 10 to 15 DPH units between loads of 15 and 500 g on mechanical and electropolished samples. The logarithmic index, n, was also determined and found to be essentially independent of composition and surface preparation for the conditions described. A value of n equal to 1.9 will correct for the change in hardness caused by a change in indenting load. This correction will permit comparison of hardness values when the indenting load is less than 1 kg. (auth)

26818 SOLVUS COMPOSITION FOR NICKEL-RICH NICKEL–ZIRCONIUM ALLOYS. Huffstutler, M. C. Jr.; Petersen, O. G. (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Inst. Metals, 94: 23-4(Jan. 1967).

Alloys were prepared with compositions in the range 1–15% Zr. It was found that a coordinated sequence of processing steps, including vacuum annealing and cold deformation, were required to promote equilibration in sintering or in conventional melted/cast material. Quantitative optical metallographic measurements gave a solid solubility at 800°C of 1.1% Zr. (UK)

26819 SOLUBILITY RELATIONSHIPS IN MAGNESIUM–MANGANESE–ZIRCONIUM ALLOYS. Vesey, I. M.; Bray, H. J. (Manchester Univ., Eng.). J. Inst. Metals, 95: 63-4(Feb. 1967).

Liquid- and solid-solubilities were determined over a series of temperatures for alloys containing up to 1% Mn, 1% Zr. The curves obtained indicate the separation of a 2 : 1 Mn : Zr compound. Implications of the results on the equilibrium diagram are discussed. (UK)

26820 THE TERMINAL SOLUBILITY OF HYDROGEN IN ZIRCONIUM ALLOYS BETWEEN 30 AND 400°C. Slattery, G. F. (United Kingdom Atomic Energy Authority, Springfields, Eng.). J. Inst. Metals, 95: 43-7(Feb. 1967).

The terminal solid solubilities (C_T) of hydrogen in Zircaloy-2, Zircaloy-4, and Zr–2½ wt. % Nb alloys were determined in the temperature region below 400°C using a dilatometric method. The solubilities obtained from the heating curves represented the true equilibrium boundaries and were not significantly different from the values for unalloyed Zr. The solubilities (ppm hydrogen by weight) can be represented by the equations: Zircaloy-2 : $C_T = 5.17 \times 10^4 \exp(-7510/RT)$, Zircaloy-4 : $C_T = 1.02 \times 10^5 \exp(-8470/RT)$, Zr–2½ wt.-% Nb : $C_T = 6.86 \times 10^4 \exp(-8070/RT)$. The values of the solubilities obtained from the cooling curves are higher because of H_2 supersaturation of the α-Zr phase. (auth)

26821 ALLOYING ELEMENTS FOR THE PRODUCTION OF HEAT-RESISTANT TITANIUM BASE ALLOYS. Glazova, V. V. Izv. Akad. Nauk SSSR, Metal., No. 1, 168-74(Jan.-Feb. 1967). (In Russian).

A classification of alloying elements for production of heat-resistant Ti-base alloys is proposed. The classification is based on the effect of the alloying elements on the characteristic temperature Θ and mean square displacements of atoms from the equilibrium position $\sqrt{\overline{U^2_{\theta}}}$, respectively. The latter two quantities were calculated using available literature data and the method of I. N. Frantsevich. The results are shown graphically. The heat resistance of Ti–Sn and Ti–Zr–Sn alloys was determined. It was concluded that the elements that increase the allotropic transition temperature of Ti also enhance the heat resistance of the metal. (ATD)

26822 HIGHLY CONDUCTIVE, LOW-ALLOY HEAT-RESISTANT COPPER. Korol'kov, A. M.; Bezus, E. V.; Gurova, L. M. Izv. Akad. Nauk SSSR, Metal., No. 1, 150-5(Jan.-Feb. 1967). (In Russian).

The effect of alloying Cu with other metals on its strength, heat resistance and electric conductivity has been investigated. A series of Cu alloys melted with small amounts of Ce, V, Zr, and other elements were tested. It was found that an Al content of 1 at. % decreases the electric conductivity of copper by more than 200%, while the same amount of Cr decreases it by only 15%. As a result, Cu alloys, containing 3 to 6% Cr or V still have high electric conductivity. Heat resistance is greatly affected by Zr and moderately affected by Ce and Ca. For instance, the rupture strength of Cu alloyed with Zr was 10 to 13 kg/mm² as compared to 3.0 to 4.0 kg/mm² for pure Cu tested at 400°C for 100 hr. The greatest strengthening of Cu can be accomplished by alloying it with two or three elements (Cu–Zr–Ce or Cu–Zr–Cr–V alloys). A good combination of electric conductivity (not less than 75% conductivity of pure Cu) and heat resistance (rupture strength 12 to 14 kg/mm² in a 100 hr test) can be obtained by alloying Cu with 2 to 3% Zr or 1.5 to 3% (Zr + Ce). (ATD)

26823 AN INVESTIGATION OF THE FATIGUE BEHAVIOR OF TUNGSTEN-REINFORCED AND STEEL-REINFORCED SILVER COMPOSITES. Morris, A. W. H.; Steigerwald, E. A. (TRW Inc., Cleveland). Trans. Met. Soc. AIME, 239: 730-9(May 1967).

The fatigue behavior of metal matrix composites in tension-tension loading has been investigated as a function of volume fraction reinforcement using the model systems of a Ag matrix reinforced with continuous or discontinuous aligned W filaments and continuous aligned steel filaments. Appreciable improvements in fatigue strength were observed in all systems investigated, the degree of strengthening increasing with increasing volume fraction of reinforcement. The mode of fatigue failure was found to be a function of volume fraction and was also noted to be controlled by the relative fatigue and strength characteristics of the matrix and reinforcement. (auth)

26824 ELECTROMIGRATION OF CADMIUM AND INDIUM IN LIQUID BISMUTH. Epstein, S. G. (Brookhaven National Lab., Upton, N. Y.). Contract AT(30-2)-Gen-16. Trans. Met. Soc. AIME, 239: 627-30(May 1967). (BNL-10635).

Using the capillary-reservoir technique, electromigration rates of Cd and In in liquid Bi were measured at several temperatures. The electric mobility of Cd from 305° to 535°C and In from 310° to 595°C can be expressed as a function of temperature. Migration of both solutes was cathode-directed at a rate more than four times that previously found for Ag in liquid Bi. The electric mobilities of Cd and In in liquid Bi at 500°C are nearly identical with their respective mobilities in Hg at room temperature. (auth)

26825 MELTING-POINT ANOMALIES. Matthias, B. T.; Zachariasen, W. H.; Webb, G. W.; Engelhardt, J. J. (Univ. of California, San Diego, La Jolla). Phys. Rev. Lett., 18: 781-4 (May 8, 1967).

Metals with much lower melting points than expected from their positions in the periodic system are La, Pa, U, and the metals in the first part of the 4f and 5f series. A reduced radius, attributed to the incomplete screening of the 4f electrons, was observed for these elements. It is suggested that the basic cause of the anomalies is the presence of some f character in the hybridized wave functions describing the band structure for the valence electrons. There was no correlation between melting point and the crystal structure of the metal immediately below the melting point. (M.C.G.)

26826 KINETICS FOR NIOBIUM DIFFUSION INTO Fe–C ALLOYS. Shantarin, V. D.; Shurygin, P. M.; Utochkin, V. V. Izv. Akad. Nauk SSSR, Metal., No. 3, 31-3(May-June 1966). (In Russian).

The rate of Nb diffusion in Fe–C alloys was studied and the kinetics of Nb dissolution in Fe–C alloys were determined at 1523 to 1723°K. (R.V.J.)

26827 THE WORK OF FRACTURE AND ITS MEASUREMENT IN METALS, CERAMICS, AND OTHER MATERIALS. Tattersall, H. G.; Tappin, G. (Atomic Energy Research Establishment, Harwell, Eng.). J. Mater. Sci., 1: 296-301(Aug. 1966).

A method of measuring the work of fracture is described and assessed. Typical values for various materials, some used in nuclear reactor components, are given and various mechanisms for the energy-absorption associated with fracture are considered. It was possible to grow cracks in a controlled manner in specimens of polycrystalline Al_2O_3, MgO, single crystal Al_2O_3, glass, reactor graphite, firebrick, wood, pottery, plastics, and a variety of metals, including Cu. If a material has either a low work of fracture or a high fracture stress, or both, hard dies are required. Since the stored elastic energy is proportioned to the square of the load, it is advantageous to shape the specimen so that fracture begins at a small load. Evidence is presented that negligible energy loss occurs during the catastrophic part of the growth, all the work done having gone in damaging the specimen. The total work done was measured by an Instron integrator connected to the testing machine. This amount of work was divided by the area of the fracture faces to give the values quoted for the work of fracture. Results of testing specimens of commercial Al_2O_3, made by various manufacturers, are shown. Using polycrystalline alumina, the effects of changing the specimen size, and the crack velocity were studied. No energy was lost owing to vibration during catastrophic crack-growth and it was concluded that differences in values obtained reflect the genuine fracture behavior of the material. The results of measuring the work of fracture of many materials (including reactor graphite) that have different mechanisms of absorbing energy during the fracture process. Impact tests made on metals to get an estimate of their toughness are described. (BBB)

26828 NIOBIUM–RHENIUM ALLOYS. (to United States Atomic Energy Commission). British Patent 1,068,987. May 17, 1967. Priority date Apr. 12, 1965, United States.

A high-strength corrosion-resistant Nb alloy is described having 66 to 96 wt % Nb based on total alloy wt and 4 to 34 wt % Re. It is noted that when Nb is alloyed with Re, the resulting alloy has a much greater tensile strength than pure Nb. The alloys can be fabricated by any of the conventional alloying techniques. (J.R.D.)

26829 SUCCESSFUL USES OF CASTINGS. NUMBER 2. New York, Climax Molybdenum Co. 20p.

The pamphlet covers a wide range of applications where Mo-containing castings are being used. These include aircraft vacuum pump rotors, cast iron brake discs for Japan's high speed trains, tank track end connectors, nuclear reactor pump casings, wire-machine drawblocks, dies, agitators, scraper arms for ore mining, high strength cast steel pipe connectors, and turbine casings. The alloy compositions suitable for these uses are discussed. (B.L.M.)

26830 MAGNETIC PROPERTIES OF Pr–La AND Pr–Y ALLOYS AND SOME INTERMETALLIC COMPOUNDS OF LANTHANIDE METALS WITH ALUMINUM, NICKEL, AND GOLD. Kissell, Fred N. Pittsburgh, Univ. of Pittsburgh, 1965. 85p. Thesis.

The bulk magnetic characteristics of these systems were studied to determine the nature of the magnetic couplings involved. Determinations were made of the dependency of susceptibility on temperature and field strength, the temperatures at which changes in magnetic structure occur, and the magnitude of the atomic moments using x-ray diffraction. An investigation of the Pr–La and Pr–Y alloy systems confirmed that a positive, ferromagnetic exchange interaction is present in Pr metal. An investigation of the compounds La_7Ni_3, Ce_7Ni_3, Pr_7Ni_3, LaAl, CeAl, PrAl, and NdAl has shown that nickel is nonmagnetic in the 7–3 compounds, and that in both series the compounds of La exhibit Pauli paramagnetism. The other compounds followed the Curie-Weiss law at high temperatures, with an effective moment equal to that of the free, tripositive lanthanide ion. At low temperatures the Al compounds were antiferromagnetic with Néel points ranging from 10°K for CeAl to 25°K for NdAl. The Ni compounds showed deviations from Curie-Weiss behavior with no ordering above 2°K. An investigation of the compounds SmAu, GdAu, TbAu, DyAu, HoAu, ErAu, TmAu, and YbAu has shown that they also obey the Curie-Weiss law at high temperatures, with a moment equal to that of the tripositive ion. At low temperatures they are, for the most part, antiferromagnetic with Néel points ranging from 8°K for SmAu to 40°K for TbAu. The compounds ErAu, TmAu, and YbAu all displayed deviations from the Curie-Weiss law at low temperatures, but gave no transition temperatures above 2°K. (auth)

26831 AMPLITUDE DEPENDENT INTERNAL FRICTION STUDIES OF ZIRCONIUM–RARE EARTH ALLOY SYSTEMS. Loh, Benjamin Tsen-Man. Troy, N. Y., Rensselaer Polytechnic Inst., 1965. 91p. Thesis.

Amplitude dependent internal friction measurements have been performed on dilute solid solutions of Zr-rare earth binary systems in an attempt to study the interactions between the rare earth solute atoms and dislocations. Measurements have been made at room temperature to 400°C by the use of an inverted torsion pendulum apparatus in which a vacuum of 1×10^{-5} torr is maintained. The rare earth elements used are Nd, Gd, Dy, and Ho. The composition of alloy specimens varies from 0.25 to 1 at.% rare earth addition. From the analysis, migration energies of 0.176 eV, 0.151 eV, 0.144 eV and 1.07 eV for Nd, Gd, Dy, and Ho are obtained, respectively; and a very low value of D_0 of the order of 10^{-18} is also obtained. From the analysis, binding energies of 0.084 eV, 0.071 eV, and 0.066 eV for Nd, Gd, and Dy are obtained, respectively. These values are about six times smaller than those calculated from Cottrell's expression for the elastic interaction of solute atoms and edge dislocations. However, for screw dislocations, the interaction will be about $\frac{1}{5}$ to $\frac{1}{10}$ smaller. The results indicate that the moving dislocations in α-Zr are principally of the screw type, and that the interaction of solute atoms and dislocations are mainly of an elastic nature based on the atomic size factor for the rare earth elements. A damping peak is observed at about 100°C for all alloy specimens. An atmosphere dragging effect is suggested as the cause of this peak. The Schoeck model for the cold-work peak is thought to be equally applicable in this case. A sum of migration energy and binding energy is obtained for the Zr–0.5% Dy system based on the Schoeck model. The value of this sum is 0.321 eV, which is in good agreement with the sum of these energies obtained from the previous two analyses. (auth)

26832 THERMOPHYSICAL PROPERTIES OF HIGH TEMPERATURE SOLID MATERIALS. VOLUME 3. FERROUS ALLOYS. Touloukian, Y. S. (ed.). New York, The Macmillan Co., 1967. 614p. $60.00.

Information on the following specific properties of ferrous alloys are tabulated: (1) density, (2) melting point, (3) heat of fusion, (4) heat of vaporization, (5) heat of sublimation, (6) electrical resistivity, (7) specific heat at constant pressure, (8) thermal conductivity, (9) thermal diffusion, (10) thermal linear expansion, (11) thermal radiative properties, and (12) vapor pressure. The term ferrous alloys is used to designate alloys in which iron is greater than or equal to any other constituent. A material name index is included. (B.L.M.)

26833 IMPROVEMENTS RELATING TO STAINLESS STEELS, PARTICULARLY FOR NUCLEAR REACTOR FUEL ELEMENTS. Cope, Lawrence Henry. (to United Kingdom Atomic Energy Authority). British Patent 1,063,372. Mar. 30, 1964. Filed Feb. 24, 1964.

A stainless steel was developed in which a fully austenitic microstructure was secured by careful balancing of such components as C, Ni, Mn, Mo, and Cr. The specified composition resulted in a steel having high rupture ductility, superior impact properties, long-term stability, good high temperature tensile strength, and resistance to structural changes caused by neutron irradiation. (P.G.C.)

26834 ZIRCONIUM ALLOYS CONTAINING CERIUM AND YTTRIUM. Rosler, U. (to Siemens-Schuckertwerke Aktiengesellschaft). Canadian Patent 753,191. Feb. 21, 1967. Priority date Sept. 29, 1962, Germany.

A new Zr alloy suitable as a structural material in nuclear reactors operating at 400 to 500°C has about 0.5% Nb and 0.02 to 0.5% Ce or Y as the added elements. Increased corrosion resistance without an appreciable increase in absorption cross section is claimed. (F.S.A.)

26835 ZIRCONIUM ALLOY. Rosler, U. (to Siemens-Schuckertwerke Aktiengesellschaft). Canadian Patent 755,579. Mar. 28, 1967. Priority date Dec. 27, 1961, Germany.

An alloy suitable as a structural material in nuclear reactors operating at 400 to 500°C has about 0.5% Nb and 0.2% Ca added to Zr. Ca improves corrosion resistance to superheated steam and the alloy mechanical strength. A small amount of one other heavy metal is also added. (F.S.A.)

Structure and Phase Studies

Refer also to abstract 26793.

26836 (AFML-TR-67-108) DEVELOPMENT AND APPLICATION OF METHODS FOR PREDICTING THE TEMPERATURE-COMPOSITION STABILITY OF REFRACTORY COMPOUNDS. Technical Report, April 1966–January 1967. Kaufman, Larry; Bernstein, Harold (ManLabs, Inc., Cambridge, Mass.). Apr. 1967. Contract AF33(615)-2352. 172p. CFSTI.

The binary systems between transition metals of the second and third series have been considered on the basis of regular solution thermodynamics. This analysis has been used to generate seventy-two binary phase diagrams between Zr, Hf, Nb, Ta, Mo, W, Re, Ru, Os, Rh, Ir, Pd, and Pt. The computed phase diagrams reflect equilibria between the bcc, hcp, fcc, and liquid phases. In addition, Laves-type compound phases in the Zr and Hf binaries and $AuCu_3$-type phases in Zr, Hf, Nb and Ta binaries are considered. The present description permits computation of the entire phase diagram, estimation of heats and free energies of formation of compound phases which occur in these systems, and calculation of the vapor pressure and rate of vaporization of elemental components as a function of temperature and composition. (auth)

26837 (NP-16702) PLASTIC DEFORMATION OF MAGNESIUM. Kelley, E. W.; Hosford, W. F. Jr. (Michigan Univ., Ann Arbor. Dept. of Chemical and Metallurgical Engineering). Feb. 1967. Contract DA-31-124-ARO-D-321. 92p.

Deformation studies have been conducted at room temperature on single and textured polycrystals of Mg and Mg alloys with Th and Li. Single crystals oriented to suppress shear on the easily activated basal slip systems were deformed by plane-strain compression. Compression along the c-axis was accommodated by $\{10\bar{1}1\}$ banding. Compression perpendicular to the unconstrained c-axis activated $\{10\bar{1}2\}$ twinning, and, after virtually complete twinning, deformation continued by $\{10\bar{1}1\}$ banding in the twinned material. Compression perpendicular to the constrained c-axis was accommodated by the simultaneous operation of $\{10\bar{1}2\}$ twinning against the constrain and $\{10\bar{1}1\}$ banding. Although this orientation was favorable for $\{10\bar{1}0\}$ $\{12\bar{1}0\}$ prism and $\{10\bar{1}1\}$ $\{12\bar{1}0\}$ pyramidal slip, these modes were not observed in pure Mg or in Mg–.5% Th. However, $\{10\bar{1}0\}$ $\{12\bar{1}0\}$ prism slip was active in crystals of Mg–4% Li during compression perpendicular to the constrained c-axis. Fracture in all materials occurred parallel to $\{11\bar{2}4\}$ or $\{10\bar{1}1\}$ depending on the orientation and composition of the specimen. (auth)

26838 THE CRYSTAL STRUCTURE OF $Cr_{11}Ge_{19}$, $Mo_{13}Ge_{23}$, AND $V_{17}Ge_{31}$. Voellenkle, H.; Preisinger, A.; Nowotny, H.; Wittmann, A. (Univ., Vienna. Technische Hochschule, Vienna). Z. Kristallog., 124: 9-25(Apr. 1967). (In German).

The crystal structures of the compounds $Cr_{11}Ge_{19}$ (isotypic with $Mn_{11}Si_{19}$), $Mo_{13}Ge_{23}$ and $V_{17}Ge_{31}$ have been determined by means of Fourier synthesis. The crystal structures are characterized by a tetragonal subcell forming a diamond-like arrangement similar to that of the Ti atoms in the $TiSi_2$ structure. The Ge deficiency according to the composition of a digermanide is correlated with the number of subcells along the c axis (11-, 13- and 17-fold subcell). (auth)

26839 STRUCTURE OF RARE EARTH–MANGANESE ALLOYS. Kirchmayr, Hans R. (Technische Hochschule, Vienna). Z. Kristallog., 124: 152-60(Apr. 1967). (In German).

The systems RE–Mn (RE = Y, La, Ce, Pr, Nd, Sm, Gd, Dy, Ho, Er) have been studied by means of the amalgam process. Three types of compounds with the formulas $REMn_2$, RE_6Mn_{23} and $REMn_{12}$ have been observed. The $REMn_2$ compounds belong to the Laves phases and crystallize either in the C14 or the C15 structure. The compounds RE_6Mn_{23} belong to the Th_6Mn_{23} type. The compounds $REMn_{12}$ belong to the $ThMn_{12}$ type. No homogeneity range has been observed in the compounds RE_6Mn_{23} and $REMn_{12}$. (auth)

26840 LATTICE SPACINGS AND EFFECTIVE ATOMIC DIAMETERS IN THE TERNARY SYSTEM Th–Ce–Zr. Norman, M.; Harris, I. R.; Raynor, G. V. (Univ. of Birmingham, Eng.). J. Less-Common Metals, 12: 465-77(June 1967).

Analysis of lattice-spacing relations in Th-rich Th–Ce–Zr alloys with Zr contents not exceeding 6 at. % shows that the large contraction for Ce atoms in dilute solution in Th is increased by the substitution for Th of the smaller Zr atom. This supports the hypothesis that Ce atoms in solid solution adopt an apparent atomic dia by further ionization of 4f electrons, which is strongly influenced by the magnitude of the compressive strain energy which would result from the solution in Th of Ce in its γ-form. This strain energy is enhanced in the ternary alloys by the substitution of Zr for Th. The apparent atomic dia is also decreased by a decrease in temperature to an extent greater than that expected from normal thermal contraction of the alloy, suggesting that 4f → conduction band transitions are encouraged by decrease in temperature. Such transitions occur at the expense of a small strain energy increase, and emphasize a tendency, previously noted, for Ce to change its effective valency towards that of the solvent in which it is dissolved. (auth)

26841 TERNARY SYSTEMS NIOBIUM–RHENIUM–CARBON AND TANTALUM–RHENIUM–CARBON. Gorshkova, L. V.; Fedorov, T. F.; Kuzma, Yu. B. (Inst. of Metallurgy, Moscow. Lvov State Univ.). Porosh. Met., Akad. Nauk Ukr. SSR, No. 4, 42-5(Apr. 1967). (In Russian).

The systems Nb–Re–C and Ta–Re–C were investigated by means of x-ray and microstructure analyses. The phase equilibria were established at 1800°C. In the cast alloys with large content of Re the metastable ν-phase was found. In the pure state the ν-phase was not obtained; this phase is at the equilibria with NbC or TaC. In the system Ta–Re the σ-phase at 1800°C does not exist. (auth)

26842 NEW TECHNIQUES FOR INDEXING X-RAY POWDER PATTERNS OF UNKNOWN STRUCTURES. Goebel, J. B.; Wilson, A. S. (Battelle-Northwest, Richland, Wash.). J. Metals, 19: 10-11; 39(May 1967).

An approach to indexing of powder patterns by computers is described in which the pattern is indexed on the basis of the highest symmetry lattice and proceeds to lower symmetry lattices. The program (INDEX) is coded so that indexing on one or all of the systems is automatic and continuous. Only one set of indices for each reflection is reported by the program, and it is necessary to use another program to obtain the positions of missing reflections. (J.R.D.)

26843 ETCHING PHENOMENA IN THE [111] PLANE OF NIOBIUM. Zedler, E. (Institut fuer Metallphysik und Reinstmetalle, Dresden). J. Appl. Phys., 38: 2046-53(Apr. 1967).

For single- and polycrystalline Nb the relation between etch figures and dislocations is qualitatively demonstrated. Repeated etching allows investigation of the movement and multiplication of dislocations. Besides triangular etch hillocks there often occur etch traces or walls, respectively, and networks that may be interpreted as dislocations lying nearly parallel to the observation plane. Etch figures of helical dislocations have been found too. (auth)

26844 ACTIVATION ENERGIES OF SEVERAL DEFORMATION MECHANISMS FROM CREEP OF URANIUM MONOCRYSTALS AND POLYCRYSTALS BETWEEN 150 AND 770°C. Grenier, P.; Lacombe, P. (Ecole des Mines, Paris). J. Nucl. Mater., 22: 241-56(1967). (In French).

Results of creep tests performed on alpha and beta U at 150 to 770°C are discussed. Variations of creep activation energies with temperature are the basis for establishment of rate controlling mechanisms. Micrographic observations confirmed the mechanisms of rate control. Creep behavior is summarized. (J.R.D.)

26845 EFFECT OF THERMAL CYCLING UPON THE TRANSFORMATION BEHAVIOR OF METASTABLE DELTA-PHASE PLUTONIUM. Spicer, B. R.; White, J. S. (Atomic Weapons Research Establishment, Aldermaston, Eng.). J. Nucl. Mater., 22: 269-75(1967).

The transformation of a metastable δ-phase Pu-0.85 at. % Ga alloy, as a result of thermal cycling, has been investigated. The decomposition of the δ phase was followed by measuring the change in density of the specimens as a function of the number of cycles. The mode of the transformation was determined by dilatometry. The results suggest that the δ phase transformed directly to the α phase. (auth)

26846 DEVELOPMENT OF LARGE ZIRCONIUM CRYSTALS BY THE ALPHA–BETA THERMAL CYCLING TECHNIQUE. Higgins, G. T.; Soo, P. (Univ. of Liverpool). J. Nucl. Mater., 22: 285-91(1967).

Large α zirconium crystals have been produced by thermally cycling iodide Zr between 840 and 1200°C. The metallographic structures and crystallographic orientations of the α crystals have been examined with the object of clarifying the mechanism by which they develop. The growth of large α crystals has been found to be dependent upon the existence of a coarse bamboo β structure prior to the final $\beta \rightarrow \alpha$ transformation. The results indicate that both the development of this β structure and its ability to transform to give individual α crystals are dependent upon the preferential growth of specific transformation variants during the $\alpha \rightleftharpoons \beta$ transitions. This is thought to arise from the fact that variants possess high rates of growth in specific crystallographic directions, together with the existence of temperature gradients along the specimen axes. The only effect of the final anneal at 840°C is to eliminate the substructures arising from the final $\beta \rightarrow \alpha$ transition. This substructure consists of two transformation variants possessing a common (0001) but misoriented 10½° about the [0001] axis. (auth)

26847 HYDROGEN SOLUBILITY IN ZIRCONIUM ALLOYS DETERMINED BY THERMAL DIFFUSION. Sawatzky, A.; Wilkins, B. J. S. (Atomic Energy of Canada Ltd., Pinawa, Manitoba). J. Nucl. Mater., 22: 304-10(1967).

The terminal solid solubility (TSS) of H_2 in Zircaloy-2 and Zr-2.5 wt % Nb annealed in the α and $(\alpha + \beta)$ regions has been determined at 300 to 515°C by making use of the thermal diffusion phenomenon. A temperature gradient impressed on a specimen initially uniformly hydrided, led to a solid solution plus hydride $(\alpha + \delta)$ region in the colder portion and a solid solution (α) in the warmer portion of the specimen. The TSS was taken to be the H_2 concentration in the α region at the $\alpha/(\alpha + \delta)$ interface. It was found that the TSS of both Zircaloy-2 and Zr-2.5 wt % Nb were given by $N = 1.99 \times 10^5 \exp(-9300/RT)$ ppm. The TSS was the same for the two heat treatments used. (auth)

26848 THE $\beta \rightarrow \alpha$ PHASE CHANGE IN A URANIUM–PLATINUM–NIOBIUM ALLOY. Kitchingman, W. J.; Pickwick, K. M. (Univ. of Manchester, Eng.). J. Inst. Metals, 95: 61-3(Feb. 1967).

An electrical-resistivity and metallographic study of the reaction in a U–0.35 at. % Pt–1.56 at. % Nb alloy is reported. The addition of Nb retards the rate of the transformation as compared with the binary U–1 at. % Pt alloy and causes separation of the high-temperature C8s found in the binary TTT curves. The transformation kinetics suggest that the high-temperature reaction is a thermally activated, diffusion-controlled process, while at lower temperatures it is probably of the bainitic type. (UK)

26849 TERMINAL SOLUBILITY AND PARTITIONING OF HYDROGEN IN THE ALPHA PHASE OF ZIRCONIUM, ZIRCALOY-2, AND ZIRCALOY-4. Kearns, J. J. (Bettis Atomic Power Lab., Pittsburgh). J. Nucl. Mater., 22: 292-303(1967). (WAPD-T-1960).

The effects of alloy composition, grain size and cold work on the terminal solubility and thermodynamic activity of H_2 in the alpha phase of Zr, Zircaloy-2, and Zircaloy-4 were determined by a diffusion sample method. The terminal solubility for Zircaloy-2 and Zircaloy-4 below 550°C was found to be given by $9.9 \times 10^4 \exp(-8250/RT)$ ppM. The solubilities given by this function approximate those given for unalloyed Zr by $1.61 \times 10^5 \exp(-8950/RT)$ ppM which is the combined result from nine investigations. The best-fit curve for the combined data for all three materials is given by $1.2 \times 10^5 \exp(-8550/RT)$. The activity of H_2 in the alpha phase, as measured by partitioning in diffusion couples, was found to vary slightly among the three materials at 329 to 796°C. An average P-C-T relationship derived from published data for these materials is represented by $C/P^{1/2} = 1.4 \times 10^{-2} \exp(11840/RT)$ at. % $mm^{-1/2}$. (auth)

26850 DECOMPOSITION OF GAMMA PHASE IN URANIUM ALLOYS CONTAINING 8, 10.8, AND 14.3 WT PERCENT MOLYBDENUM. Goldstein, Y.; Bar-Or, A. (Israel Atomic Energy Commission, Tel-Aviv). J. Inst. Metals, 95: 17-21 (Jan. 1967).

The kinetics of decomposition of the γ phase in various U–Mo alloys (8, 10.8, and 14.3 wt.-%) was studied by x-ray powder diffraction. A number of experimental difficulties encountered in the powder-diffraction method were solved. TTT curves for the $\gamma \rightarrow (\alpha + \gamma)$ and the $\gamma \rightarrow (\alpha + \gamma + \gamma')$ transformation were determined. Each TTT curve has a typical C-shape. The maximum times for the initiation of both transformations are strongly dependent on temperature. This dependence is different for the two transformations. Activation energies for the growth of α and γ' were determined. The energy values for alloys of the same composition were almost identical for the α and the γ' transformation. The similarities between the activation-energy data for diffusion in U/U–Mo couples, reported by Adda and Philibert, and those reported here for the growth of α and probably for γ' may indicate that the two processes are controlled by the same mechanism. The times to appearance of α and γ' were shorter than those cited by other workers. This could be due to the use of powder in the present study, which may accelerate the transformation by nucleation on the powder-particle surface. (auth)

26851 THE STUDY OF POINT DEFECTS IN METALS AT THE MAX-PLANCK-INSTITUT FUER METALLFORSCHUNG AND THE TECHNISCHE HOCHSCHULE STUTTGART. Schumacher, D. (Centre d'Etudes Nucleaires, Grenoble, France). Metals Mater., 1: 150-2(May 1967).

The study of point defects has been an essential part of the investigations performed to study the defect solid state of metals. Throughout the investigations both the theoretical and the experimental side of the field have been emphasised, leading to most fruitful interactions between these two approaches. In the theoretical field, the calculation of defect properties from first principles (electron theory of metals) on crystal models predominated. In addition, more applied calculations on kinetic problems, in conjunction with the interpretation of experimental data, were carried out. In the experimental field, the techniques of quenching, cold-work, and irradiation were used to introduce point defects into metals. The detection of point defects and the investigation of their properties involved the following techniques: electrical resistivity at 77 or 4.2°K, magnetic susceptibility, coercive force, magnetic after-effects, internal friction, x-ray small angle scattering, and transmission electron microscopy. (auth)

26852 ELECTRON METALLOGRAPHY OF PRECIPITATES IN IRRADIATED AND UNIRRADIATED STAINLESS STEEL. Ranzetta, G. V. T.; Scott, V. D. (Atomic Weapons Research Establishment, Aldermaston, Eng.). Metals Mater., 1: 146-50(May 1967).

The use of individual electron-metallographic techniques may not give results that are positive enough for certain investigations, for example in studies of fine-scale precipitation phenomena. The use of "paired" techniques in overcoming this difficulty is described. Electron microscopy, diffraction, and electron probe microanalysis were applied to the identification of small particles in a stainless steel containing (wt.-%) 20 Cr : 25 Ni : 0.7 Nb. Analysis of the experimental data revealed that two types of precipitate were present–a simple carbide, NbC, and a complex carbide based on the $[Ni + (Fe + Cr)]_3 \cdot Nb_3C$ phase. (auth)

26853 BAINITIC REACTION IN URANIUM–CHROMIUM ALLOYS. Amity, I.; Rosen, A.; Bar-Or, A. (Israel Atomic Energy Commission, Tel-Aviv). J. Inst. Metals, 95: 48-52 (Feb. 1967).

The structure formed upon isothermal heat-treatment of U–Cr alloys in the region of the intermediate C curve was investigated. Two types of acicular grain structure were found: white and rather large proeutectoid needles, with a strong orientation-dependence, assumed to be Widmanstätten structure, and bainite plates. The longitudinal and transverse growth of the bainite plates was measured for two alloys at various temperatures. Activation energies were calculated from the temperature-dependence of the growth rates. The results are discussed and compared with known models. (auth)

26854 INFLUENCE OF ADDING NICKEL ON THE PHASE COMPOSITION OF IRON–BERYLLIUM ALLOYS. Umanskii, Ya. S.; Shevkun, I. G. Izv. Akad. Nauk SSSR, Metal., No. 1, 145-6(Jan.-Feb. 1967). (In Russian).

The effect of additions of Ni to Fe–Be alloys on the phase composition of the latter was investigated. The alloy specimens (of approximately 70 g each) were prepared from Ni, Be, and Fe powder in an arc furnace at 1170°C under an atmosphere of Ar. The phase composition was determined by x-ray diffraction and by microstructural methods. The experimental results are summarized graphically and in tables. It was found that small additions of Ni (0.75%) to the Be–Fe alloy prevent the formation of $FeBe_2$ crystals. The observed change in the crystal lattice parameter of FeBe alloys after additions of Ni was concluded to be caused by a displacement of Fe atoms by Ni atoms. (ATD)

26855 THERMAL ETCHING OF β-ALLOY OF THE SYSTEM Ti–Mo–Fe–Al. Ageev, N. V.; Petrova, L. A.; Matveeva, M. P.; Grankova, L. P. Izv. Akad. Nauk SSSR, Metal., No. 1, 165-7 (Jan.–Feb. 1967). (In Russian).

Microstructure of the β-modification of the Ti + 2.92 Mo + 7.94 Fe + 4.07 Al (wt %) alloy was investigated. The experimental procedure involved a high-temperature vacuum microscopic study of the microstructure of etched polished sections of cylindrical specimens 12 mm in diameter and 4.8 mm in height. The specimens were etched with HF for 1 hr, with HNO_3 for 0.5 hr, and were held in water 4 hr and in glycerine for 8 hr. The results are shown graphically. It was concluded that high-temperature etching techniques afford a method for the study of dislocations in titanium alloys. (ATD)

26856 PHASE DIAGRAMS OF THE Th–Pr AND Th–Nd SYSTEMS. Badaeva, T. A.; Kuznetsova, R. I. Izv. Akad. Nauk SSSR, Metal., No. 1, 175-81(Jan.-Feb. 1967). (In Russian).

A study was made of 16 Th–Pr and 16 Th–Nd alloys. Alloys were melted from 99.5%-pure Th, Pr (containing such impurities as 0.35% Cu, 0.25% Ca, and 0.037% Fe), and Nd (containing a total of 0.107% impurities such as La, Fe, Cu, and Ca). On the basis of data obtained, phase diagrams of the Th–Pr system and Th–Nd system were plotted. The presence of a continuous series of solid solutions between high-temperature modifications of these metals was established. It was shown that solid-state transitions in reactions $\beta_{Th-Nd} + \alpha_{Th} \rightleftharpoons \alpha_{Nd}$ and $\beta_{Th-Nd} + \alpha_{Th} \rightleftharpoons \alpha_{Nd}$ at 940 and 950°C, respectively, were of a peritectoid type. A wide range of α-Th-base solid solutions was found in both systems. It extended to 80 at. % Pr at 650°C and to 78 at. % Nd at 750°C. The solubility of Th in Pr and Nd, at these temperatures, was found to be below 1 at. %. (ATD)

26857 THE COMPOUNDS Eu_2Ni_{17} AND $EuNi_5$ AND THEIR CRYSTAL STRUCTURES. Terekhova, V. F.; Kripyakevich, P. I.; Frankevich, D. P.; Torchinova, R. S. Izv. Akad. Nauk SSSR, Metal., No. 1, 205-7(Jan.-Feb. 1967). (In Russian).

The system Eu–Ni containing 93.6 to 99.7 at. % Ni and 81.1 at. % Ni, respectively was investigated. The investigation was carried out by x-ray powder analysis of alloys prepared in an atmosphere of purified He at an ambient pressure of 0.5 atm. The experimental results are tabulated. Existence of the following compounds in the system was established: Eu_2Ni_{17}, crystal type Th_2Ni_{17}, a = 8.35 Å; c = 8.06 Å; and $EuNi_5$, crystal type $CaCu_5$, a = 4.911 ± 0.004 Å, c = 3.965 ± 0.002 Å. (ATD)

26858 ELECTRON MICROSCOPY BY SECONDARY EMISSION UNDER ION BOMBARDMENT: CONTRAST OF IMAGES. Fagot, Bernard; Fert, Charles (Faculte des Sciences, Toulouse). J. Microscop., 4: 21-32(1965). (In French).

Instrumentation and techniques are described for use of secondary electron emission produced by an ion beam to examine the ultrastructure of metal crystals. In the procedure described, Ar^+ ions are accelerated at energies up to 90 kv whereupon they impinge upon the object at angles of 25 to 70°. The secondary electrons emitted by the irradiated object are then accelerated at 20 to 60 kv and focused by a system of electron lenses. The study of ion-induced secondary emission of monocrystals provided new data on contrast analysis. After a description of the modification made in the secondary emission microscope, an analysis of relief contrast is presented and commented on, with specifications on the conditions under which the samples must be prepared. Some results obtained on Al, Zn, and Ni–Cr obtained with a 50-kv Ar^+ ion beam are illustrated. (BBB)

26859 CONSTITUTION OF BINARY ALLOYS OF GADOLINIUM, DYSPROSIUM, HOLMIUM, AND ERBIUM WITH MANGANESE. Kirchmayr, Hans Rudolf; Lugscheider, Walter (Technische Hochschule, Vienna). Z. Metallk., 58: 185-8 (Mar. 1967). (In German).

The alloying behavior of rare earth metals with other transition metals and the alloy systems of Gd, Dy, Ho, and Er with Mn were investigated. The complete constitutional diagrams containing the stability ranges of the intermetallic phases $ReMn_2$, Re_6Mn_{23} and $ReMn_{12}$ were established. The formula of the compound Re_6Mn_{23} which is isotypic to Th_6Mn_{23} could be corroborated by quantitative differential thermal analysis of the system Gd–Mn. (auth)

26860 CRYSTALLOGRAPHY OF CEMENTITE PRECIPITATION IN THE BAINITE TRANSFORMATION. Shackleton, D. N. (British Welding Research Association, Cambridge, Eng.); Kelly, P. M. Acta Met., 15: 979-92(June 1967).

The orientation relationships between cementite and ferrite in both upper and lower bainite have been determined using transmission electron microscopy and diffraction from thin foils of isothermally transformed Cr–Mo–B steels. In lower bainite the tempering relationship: $(001)_{Fe_3C} \parallel (211)_\alpha$ $[100]_{Fe_3C} \parallel [0\bar{1}1]_\alpha$ $[010]_{Fe_3C} \parallel [1\bar{1}\bar{1}]_\alpha$ was obeyed in every case except one, while in upper bainite just under $^2/_3$ of the observed diffraction patterns were consistent with this relationship. The remaining upper bainite patterns could only be analyzed by relating both the cementite and the ferrite to the parent austenite. A stereographic method of carrying out this analysis is described. The orientation relationship results suggest a transformation mechanism in which cementite always precipitates within the ferrite in lower bainite, while in upper bainite the cementite and ferrite can form separately in the parent austenite and need not be related, except via their common parent phase. These conclusions are supported by the results of habit plane and direction determinations for cementite in both upper and lower bainite. (auth)

Radiation Effects

26861 (BNWL-CC-658) IRRADIATION EFFECTS ON REACTOR STRUCTURAL MATERIALS. Quarterly Progress Report, February–April 1966. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). May 1966. Contract AT(45-1)-1830. 224p. Dep. CFSTI.

Developments are reported for studies on: radiation damage studies on reactor metals; radioinduced properties changes in stainless steel; radiation effects on iron and stainless steel; effects of substructure of irradiation stability of steel; fracture toughness of reactor pressure vessel steels; radiation effects on steels; effects of Ni content on irradiated Cr–Mo–Ni steel; radiation embrittlement of high-strength steels; effects of neutron spectra on observed changes in notch ductility of irradiated steels; radiation effects on refractory metals and heat resistant alloys; radiation effects on fuel cladding materials; in-reactor measurements on mechanical properties; in-reactor oxidation of Zircaloy-2; dynamic materials test apparatus; irradiation damage in Ni-base alloys; radiation effects on fracture properties of annealed Zircaloy-2; gas loop development; radiation effects on metals; damage mechanisms; nuclear reactions in metals; and in-reactor fatigue testing of reactor structural steels. (P.C.H.)

26862 (BNWL-SA-777) PHYSICAL CHARACTERIZATION OF MOLYBDENUM SINGLE CRYSTALS FOR IRRADIATION EXPERIMENTS. Kissinger, H. E.; Brimhall, J. L.; Mastel, B. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Nov. 1966. Contract AT(45-1)-1830. 21p. (CONF-661126-1). Dep. CFSTI.

From International Conference on Characterization of Materials, University Park, Pa.

Radiation effects on near-perfect high-purity Mo single crystals were investigated. It was found that neutron irradiation of such crystals creates point defects, vacancies and interstitials. The interstitials interact to form two-dimensional clusters which serve as sinks for additional interstitials. Vacancies persist as isolated defects on very small clusters coherent with the original clusters. Black spots observed by electron microscopy are interpreted as interstitial clusters which grow with increasing exposure. (J.R.D.)

26863 (BNWL-SA-822) IN-REACTOR OXIDATION OF ZIRCONIUM ALLOYS IN pH–10 LiOH AND pH–10 NH_4OH. Johnson, A. B. Jr. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). [1966]. Contract AT(45-1)-1830. 26p. (CONF-670312-2). Dep. CFSTI.

From 23rd Annual Meeting of The National Association of Corrosion Engineers, Los Angeles, Calif.

Results of in-flux corrosion studies in the G-7 loop of the Engineering Test Reactor are summarized. Corrosion data were obtained from tensile specimens and from coupons of two sizes. Six Zr alloys were exposed in various combinations in three G-7 loop environments: pH-10 LiOH, ~1 ppm O_2, pH-10 LiOH, ~0.1 ppm O_2 and pH-10 NH_4OH, <0.05 ppm O_2. Alloys exposed in the lithiated environments consistently underwent pronounced flux-induced oxidation. In the ammoniated environment, flux-induced oxidation was small or absent on specimens exposed as-etched. However, three of six alloys exposed after prefilming at 400°C in 1500 psi steam underwent considerable flux-induced oxidation. Specimens prefilmed at 300°C also show accelerated oxidation, but not to the degree observed on specimens prefilmed at 400°C. Specimens exposed at G-7 loop out-of-flux positions ~1 sec and ~1 min from the flux did not differ significantly in oxidation rate or hydrogen pickup. Hydrogen pickup was not significantly accelerated by flux unless the oxidation rate was affected. Exposures in the irradiated ammoniated coolant also show little effect of the H_2 in the coolant on hydrogen pickup after 77 days. Results from the G-7 loop exposures and from Zr alloy corrosion in other reactors are consistent with the view that accelerated oxidation is dependent on the dissolved O_2 level in the coolant. (auth)

26864 (BNWL-SA-972) STATUS OF PROGRAMS FOR BEHAVIOR OF IRRADIATED MATERIALS IN LIQUID SODIUM FAST BREEDER REACTORS. Claudson, T. T. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). [1966]. Contract AT(45-1)-1830. 27p. (CONF-661102-34). Dep. CFSTI.

From American Society of Mechanical Engineers, Winter Annual Conference, New York.

The status of advanced materials for the reactors is summarized. Information is included on development programs such as those associated with the Fast Flux Test Facility and the Liquid Metal Breeder Reactor Program. The major Na technology programs at BNWL, GE, MSAR, BNL, AI, APD, ANL, LASL, WAPD, and NRL are summarized. (J.R.D.)

26865 (HW-74679) IRRADIATION EFFECTS ON REACTOR STRUCTURAL MATERIALS. Quarterly Progress Report, May–July 1962. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). Aug. 15, 1962. Contract AT (45-1)-1350. 212p. Dep. CFSTI.

The 19 articles included contain information on: radiation damage in different reactor spectra; irradiation surveillance program on AISI 347 stainless steel; neutron irradiation effects on properties of Fe and other bcc metals; effects of neutron irradiation on materials subjected to multiaxial stress distributions; irradiation damage to reactor metals; in-reactor measurements of mechanical properties; damage mechanisms; irradiation and environmental effects; radiation effects on structural materials; radiation effects on high-temperature alloys; theory of the dependence of radioinduced diffusion on the displacement production rate and irradiation temperature; radiation effects on atomic rearrangements in Cu–Al; stress relaxation in Fe–C and Fe–N alloys; atomic rearrangements in deformed Cu–Si and Cu–Si–Mn alloys; in-reactor stress rupture properties of some structural alloys; impact tests on irradiated pressure vessel steels; and fast neutron dosimetry and in-pile fatigue. (P.C.H.)

26866 (HW-75500) IRRADIATION EFFECTS ON REACTOR STRUCTURAL MATERIALS. Quarterly Progress Report, August-October 1962. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). Nov. 15, 1962. Contract AT(45-1)-1350. 250p. Dep. CFSTI.

Research at Argonne National Laboratory, Battelle Memorial Institute, General Atomic Division, Hanford Laboratories, Naval Research Laboratory, Nuclear Materials and Propulsion Operation, Oak Ridge National Laboratory, and Phillips Petroleum Company is reviewed. (M.C.G.)

26867 (HW-76635) IRRADIATION EFFECTS ON REACTOR STRUCTURAL MATERIALS. Quarterly Progress Report, November 1962–January 1963. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). Feb. 15, 1963. Contract AT(45-1)-1350. 206p. Dep. CFSTI.

26868 (HW-77281) IRRADIATION EFFECTS ON REACTOR STRUCTURAL MATERIALS. Quarterly Progress Report, February–April 1963. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). May 15, 1963. Contract AT (45-1)-1350. 312p. Dep. CFSTI.

Research at Argonne National Laboratory, Battelle Memorial Institute, Brookhaven National Laboratory, General Atomic Division, Hanford Laboratories, Naval Research Laboratory, Nuclear Materials and Propulsion Operation, Oak Ridge National Laboratory, Phillips Petroleum Company, and Southwest Research Institute is summarized. (M.C.G.)

26869 (HW-83398) IRRADIATED EFFECTS ON REACTOR STRUCTURAL MATERIALS. Quarterly Progress Report, May–July 1964. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). Aug. 15, 1964. Contract AT (45-1)-1350. 373p. Dep. CFSTI.

Developments are reported for studies on: radiation effects on mechanical properties of AISI Type-347 stainless steel; effects of neutron radiation on properties of pure iron and other bcc metals; neutron radiation effects on materials subjected to multiaxial stress distributions; radiation effects on reactor metals; in-reactor measurements of mechanical properties; irradiation facilities operation; irradiation damage to Zircaloy-2, stainless steels, and nickel-base alloys; damage mechanisms; environmental effects; corrosion of ATR loop structural materials; gas-solid reactions at high temperatures; gas chromatograph; radiation effects on corrosion of PRTR Zircaloy-2 process tubes; thermal cycling effects on oxidation of Zircaloy-2; corrosion of mechanically flexing autoclaved Zircaloy-2; zirconium hydriding mechanism; hydride moderators; tube burst testing of irradiated Zircaloy-2 pressure tubes; neutron damage to metals; radiation effects on structural steels; radiation effects on refractory metals and alloys at high temperature; annealing of Cu–Ni alloys following neutron irradiation, quenching, deformation; radiation effects on Fe, Fe alloys, and steels; Charpy impact machine calibration; in-reactor fatigue testing of reactor structural steels; and nondestructive testing instrumentation for reactor pressure vessels. (P.C.H.)

26870 GRAIN BOUNDARY MIGRATION AND GROWTH OF GAS BUBBLES IN NEUTRON IRRADIATED Al–Li ALLOYS. Shiraishi, Kensuke (Japan Atomic Energy Research Inst., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 4: 136-42(Mar. 1967).

The electron microscope was used to observe the behavior of He gas bubbles in cold-worked Al–Li alloys upon post-irradiation heating. The bubbles appeared occasionally along the grain boundary in the Al–2.7 wt % Li specimen irradiated to 4.1×10^{19} n/cm^2 and then heated to about 300°C. Upon heating to higher temperatures, up to 450°C, the bubbles in the specimen grew along with the gradual growth of the recrystallized grains. When the bubbles reached sizes of 0.3 to 0.6 μ, upon heating to 500°C, the grain boundaries migrated, leaving the bubbles detached from them. In the Al–0.4 wt % Li specimen, the bubbles migrated out of the specimen surface, along with the grain boundary, upon heating to the temperatures above 450°C. The grain sizes of the irradiated Al–2.7 wt % Li specimen heated for 1 hr to 450°C were smaller than in unirradiated specimen heated for 1 hr to 400°C. In the displacement of grain boundary caused by grain growth, the gas bubbles were swept together to form larger bubbles until they reached a certain critical size. As the bubbles became larger, they detached from the moving boundary. The bubbles impeded the grain boundary movement, but did not suppress it completely. The bubbles found on the grain boundaries differed in shape from the bubbles that had grown in the grain interior. (auth)

26871 SOME EFFECTS OF PROTON, ELECTRON, AND NEUTRON IRRADIATION ON THE FATIGUE PROPERTIES OF COPPER SINGLE CRYSTALS. Adamson, R. B. (Univ. of Wisconsin, Madison). Trans. Met. Soc. AIME, 239: 714-20(May 1967).

The fatigue behavior of irradiated copper single crystals is compared to that of unirradiated crystals. Proton or electron irradiation did not substantially change the fatigue-life, fatigue-hardening, or slip-line characteristics, while neutron irradiation did appear to alter these parameters. Postfatigue transmission electron microscopy did not reveal any marked structural differences between irradiated and unirradiated specimens. Possible dislocation mechanisms to explain the observed behavior are discussed. (auth)

26872 THE INFLUENCE OF THE SPECIFIC RADIOACTIVITY OF THE ^{124}Sb ISOTOPE ON THE DIFFUSION OF ANTIMONY IN GERMANIUM. Arakelyan, V. S.; Spitsyn, Vikt. I. (Inst. of Physics and Chemistry, Moscow). Dokl. Akad. Nauk SSSR, 170: 1352-5(Oct. 21, 1966). (In Russian).

The effect of the specific radioactivity of ^{124}Sb on the diffusion of Sb in Ge was examined, using specimens consisting of one n-type Ge single crystal alloyed with Sb and two p-type single crystals of Ge alloyed with Ga; the dislocation density and electrical parameters of the materials used were known. The specimens were cut to ensure diffusion in the (111) direction. The diffusion was initiated from the gas phase in Ar-filled quartz ampoules, with 2 mg of Sb possessing a known ^{124}Sb activity, at 684, 704, 770, 850, and 859°C for periods ranging from 40 min to 88 hrs. The distribution of the Sb in the Ge was determined by removing layers from the specimen by etching with HF + HNO_3 or boiling it in H_2O_2 and measuring the activity of the solution. The results indicated that in addition to the specific activity of the diffusing element, the temperature of diffusion annealing, the concentration in the gas phase and at the surface played an important role. Formation of Ge_xSb_y type complexes slow down the diffusion. The specific activity acts probably by disrupting the bonds, resulting in the formation of free Sb atoms, thus shifting the equilibrium between the Sb in the gas phase and the subsurface layer. (TTT)

Ceramics and Cermets

Corrosion and Erosion

Refer also to abstracts 26747 and 26761.

26873 (ORNL-4014) COMPATIBILITY OF PYROLYTIC-CARBON COATED FUEL PARTICLES WITH WATER VAPOR. Blood, C. M.; Overholser, L. G. (Oak Ridge National Lab., Tenn.). Nov. 1966. Contract W-7405-eng-26. 30p. Dep. CFSTI.

The oxidation of various lots of coated fuel particles by water vapor was studied at 1000°C using He–water vapor mixtures having partial pressures of ~4.6, 46, and 567 torr and a total pressure of 1 atm. Rates of reaction of water vapor with pyrolytic C coatings were determined from weight losses and, in a few instances, from flow rates and analyses of effluent gases. Surface area measurements of coated fuel particles were made before and after oxidation by water vapor. Incidence of failure of coatings was determined from the amount of U leached out of the oxidized coated fuel particles. Surface area development by oxidation with water vapor could not be correlated with reaction rates. The effects of partial pressure of water vapor on the reaction rates also were obscure. Experiments made in graphite containers indicated that graphite can protect the coated fuel particles from oxidation by water vapor. Photomicrographs of a number of oxidized fuel particles are included. (auth)

26874 DETERMINING THE THICKNESS OF A FURNACE LINING BY MEANS OF NEUTRON ACTIVATION. Jordan, Edward D. (to U. S. Atomic Energy Commission). U. S. Patent 3,315,076. Apr. 18, 1967.

A method of detecting wear of the fire brick furnace lining which protects the external metal shell from the hot molten metal is described that comprises positioning borated bricks within the lining adjacent to said shell, at predetermined positions, periodically irradiating using thermal neutrons at the predetermined positions, detecting and counting .477-MeV gamma rays emitted from said brick, and indicating when the count is below a predetermined value. (AEC)

Preparation and Fabrication

Refer also to abstracts 25864, 25964, 27824, 27836, 27845, and 27846.

26875 (ANL-7301) PREPARATION OF URANIUM MONOCARBIDE BY REACTION IN A LIQUID-METAL MEDIUM. Petkus, E. J.; Johnson, T. R.; Steunenberg, R. K. (Argonne National Lab., Ill.). Mar. 1967. Contract W-31-109-eng-38. 33p. Dep. CFSTI.

A method of producing UC by direct combination of the two elements is described. A liquid Zn−Mg alloy medium is used to promote the reaction between dissolved U and suspended C. Agitation of the melt promotes intimate contact between the reactants and allows the reaction to proceed at 700 to 800°C. (J.R.D.)

26876 (LA-3686) ADVANCED PLUTONIUM FUELS PROGRAM QUARTERLY STATUS REPORT, JANUARY 1-MARCH 31, 1967. (Los Alamos Scientific Lab., N. Mex.). Apr. 24, 1967. Contract W-7405-eng-36. 42p. Dep. CFSTI.

Developments are reported for studies on: release, distribution, and removal of fission products in Na coolant systems; measurement of impurities and development of quality control techniques for high temperature sodium coolant systems; kinetics of Na cold traps; ceramic Pu fuel materials; compatibility of Na-bonded (U,Pu)C and (U,Pu)N fuels with cladding materials; reactor nuclear analysis methods and concept evaluations; testing and evaluation of neutron cross sections for reactor calculations; and advanced measurement and analysis technology. (P.C.H.)

26877 (TID-23704) PURIFICATION AND CRYSTALLIZATION OF AMORPHOUS BORON POWDER; RECOVERY AND PURIFICATION OF BORON FROM RESIDUES AND SCRAP. Technical Report, July 1-December 31, 1966. Musgrave, John R.; Starks, Ralph J.; Erwin, Harold E.; Fluesmeier, A. L.; Buford, John T.; Biggerstaff, George E. (Eagle-Picher Industries, Inc., Miami, Okla. Miami Research Labs.). Jan. 15, 1967. Contract AT(40-1)-3327. 45p. Dep. CFSTI.

A process for preparation of high-purity ^{10}B by hot-wire deposition is presented in detail. A particle-size analysis using micromesh sieves is described, which gives good reproducibility and appears to have advantages over present methods. A horizontal zone-refining method yielding good purity and recovery is summarized. (auth)

26878 (AD-649412) METHOD OF OBTAINING VACUUM-TIGHT CERMET JOINTS. Makarkin, A. Ya.; Metelkin, I. I. Translated from Russian Patent No. 175865. 6p. (FTD-HT-66-711). CFSTI.

A method is described for obtaining vacuum-tight cermet junctions by metallizing the ceramics and soldering with hard solders. To avoid destroying the metallized layer, to simplify the technique, and to lower the temperature of paste infusion, soldering is carried out directly along the metallized layer formed by the infusion of Mo−Mn paste. (tr-auth)

26879 INVESTIGATION OF SINTERING AND PROPERTIES OF SOLID SOLUTIONS OF TiC AND ZrC CARBIDES WITH NbC. Gropyanov, V. M.; Sobolev, V. G. (All-Union Scientific-Research Inst. of Refractory Materials, Leningrad). Porosh. Met., Akad. Nauk Ukr. SSR, No. 4, 30-3(Apr. 1967). (In Russian).

It is shown that application of finely-dispersed powders of solid solutions of refractory carbides can considerably activate the sintering process. The values of the elastic and durability high-temperature properties of compactly sintered samples of solid solutions of refractory carbides, are somewhat higher than in the initial materials. (auth)

26880 INVESTIGATION OF THE DEPOSITION OF MOLYBDENUM CARBIDE FILMS FROM MOLYBDENUM HEXACARBONYL USING AN ELECTRON BEAM. Vishnyakov, B. A.; Osipov, K. A. (Baikov Metallurgy Inst., Moscow). Soviet Phys.-Solid State (Engl. Transl.), 8: 2976-7(June 1967).
Translated from Fiz. Tverd. Tela, 8: 3706-8(Dec. 1966).

Factors affecting the rate of growth of MoC films prepared by deposition from $Mo(CO)_6$ and bombardment with an electron beam were investigated. It was found that the rate of growth decreased when the substrate temperature was increased but was independent of the electron energy. The rate was a linear function of the density of the electron-beam current. Electron-diffraction data indicated that the MoC films obtained had the cubic structure. The experimental results were in good agreement with theoretical calculations. (A.G.W.)

26881 FURNACE FOR THE MANUFACTURE OF FISSILE AND/OR FERTILE NUCLEAR FUEL CARBIDES. Beucherie, Pierre; Wurm, Joseph Gerard (to European Atomic Energy Community (EURATOM)). British Patent 1,069,244. May 17, 1967. Priority date July 5, 1963, Germany.

A high-frequency induction furnace is described for use in the manufacture of fissile and/or fertile nuclear fuel carbides or in the regeneration of these. The reaction components are charged through a central open-top hearth positioned within a supporting vessel having a cover with an aperture for gas passage. A field concentrating device including a body with hollow walls surrounds the supporting vessel and is adapted to lead the field to the walls of the hearth. This body is closed at the bottom end to provide a support for the supporting vessel and extends towards the top of the furnace to form a condenser with the hollow walls. The condenser is provided with a cooling fluid. A quartz tube surrounds the field concentrating device, and an induction heating means including an induction coil surrounds the quartz tube and the hearth. (B.L.M.)

26882 APPARATUS FOR PRODUCING COATED PARTICLES. Shapiro, Zalman Mordecai (to Nuclear Materials and Equipment Corp.). British Patent 1,068,815. May 17, 1967. Filed July 30, 1965.

An apparatus for producing particles coated with a vaporizable coating material includes a rotatable receptacle having an inclined internal surface, means for depositing the particles in the receptacle in such a manner that the particles have free access to the surface, means for producing a vapor over the surface, and means for rotating the receptacle to cause the particles to move along the surface and to be coated. The apparatus is particularly applicable to the production of coated reactor fuel particles. (B.L.M.)

26883 THORIUM OXIDE OR THORIUM-URANIUM OXIDE WITH MAGNESIUM OXIDE. Russell, E. R.; Prout, W. E.; Groh, H. J.; Watt, G. W. (to U. S. Atomic Energy Commission). U. S. Patent 3,309,323. Mar. 14, 1967.

An improved ThO_2 or $ThUO_2$ nuclear fuel material having between about 0.5 and 1.6 wt % MgO intimately dispersed throughout the material is disclosed. The addition of MgO in these small amounts in the sol-gel process for preparing ThO_2 substantially improves the dissolution properties of this fuel material. (AEC)

26884 PREPARATION OF PLUTONIUM OXIDE SOL AND CALCINED MICROSPHERES. Lloyd, M. H. (to U. S. Atomic Energy Commission). U. S. Patent 3,310,386. Mar. 21, 1967.

In a method for preparing a low-nitrate stable PuO_2 sol a first sol is formed by dispersing a washed, hydrous PuO_2, formed by neutralization of a HNO_3 solution containing tetravalent Pu with a strong base, in an aqueous solution containing 1 to 4 moles HNO_3 per mole of Pu and heating under controlled conditions. This sol is evaporated to dryness. The resulting solids are heated at a temperature below 200°C until the residual nitrate content is 0.4 to 0.1 mole per mole Pu and then dispersed in water to form the second sol. (AEC)

26885 COATING PROCESS. Faussat, Armand (to Commissariat a l'Energie Atomique). British Patent 1,069,187. May 17, 1967. Priority date June 26, 1964, France.

A method of coating metal or ceramic components with graphite particles is described. The graphite particles, less than 10 μ dia, are dispersed in an organic solvent. The solvent is sprayed toward the object to be coated and an induced potential difference between the droplets and the component cause the droplets to form a mist and precipitate the graphite on the component. A thin uniform coating results. (J.R.D.)

26886 PROCESS AND APPARATUS FOR PRODUCING ELONGATED RODS. Gayet, Bernard; Holder, Jean (to Commissariat a l'Energie Atomique). British Patent 1,063,598. Mar. 30, 1967. Priority date Nov. 6, 1963, France.

Equipment and techniques are described for production of dense rods from compacts of non-insulating refractory materials having melting points of at least 1900°C. The process consists of stacking the compacts end to end, moving the stack through an induction coil to melt the center of the stack, and then moving the stack to a cooling zone where it is bonded and densified. Specifically the method is applicable to the formation of nuclear fuel elements such as UO_2 because the material produced is of high purity and density and may be directly densified in a fuel element can after crushing. (P.G.C.)

26887 METHOD AND CATALYST FOR COMBINING HYDROGEN AND OXYGEN IN THORIUM OXIDE SLURRIES. Hanson, C. K.; Horton, R. M.; Wadsworth, M. E. (to U. S. Atomic Energy Commission). U. S. Patent 3,312,526. Apr. 4, 1967.

A method is described of combining H_2 and O_2 in an aqueous ThO_2 slurry by reacting an aqueous ThO_2 sol and platinic acid at a Th-to-Pt ratio of 2−3 to 1 and then recovering the resulting suspended solids and dispersing them in the slurry. (AEC)

26888 IMPROVEMENTS IN OR RELATING TO TREATMENT OF NUCLEAR FUEL MATERIALS. Dell, Ronald Michael; Carney, Reginald Frederick Arthur; Allbutt, Martin (to United Kingdom Atomic Energy Authority). British Patent 1,060,130. Feb. 22, 1967. Filed Dec. 10, 1964.

A procedure is described for production of high density nuclear fuels of the sulfides and phosphides of U, Th, and Pu. Densification is accomplished by hot pressing the sulfide or phosphide powders in cylindrical graphite dies lined with a refractory metal sheet, Mo, Ta, or W, at 1300 to 1860°C, and at pressures of 2 to 3 tsi. Density of a US body, produced by this method, is 98% of theoretical. (P.G.C.)

26889 METHOD FOR PRODUCING U–UC CERMETS. Kido, Tatsuro (to Japan Atomic Energy Research Inst.). Japanese Patent 1966-9998. May 27, 1966. Filed Oct. 5, 1962.

A process for making U–UC cermets consists of cold-pressing a mixture of UO_2 and C, (or graphite) powders, in which the amount of C is larger than the mole ratio of 1 : 2, into a suitable form, and heating the compact at 1800 to 1900°C in a vacuum of 1×10^{-3} mm Hg (or higher). (P.G.C.)

26890 OPENLY POROUS REFRACTORY NUCLEAR FUEL MICROSPHERES AND METHOD OF PREPARATION. Gens, T. A. (to U. S. Atomic Energy Commission). U. S. Patent 3,320,179. May 16, 1967.

A porous refractory microsphere fuel particle selected from ThO_2, UO_2, PuO_2, and mixtures having an open porosity of at least 15% of the particle volume is described. The surface pores of the particle communicate with inner pores of the particle. A method for preparing these porous microspheres comprises incorporating a volatile inorganic material within gel microspheres and then calcining the material to volatilize off the inorganic material and effect pore formation. (AEC)

26891 METHOD OF PRODUCING NUCLEAR FUEL ELEMENTS OF STAINLESS STEEL COATED UO_2 PARTICLES. Goslee, D. E.; Frank, L. (to U. S. Atomic Energy Commission). U. S. Patent 3,318,695. May 9, 1967.

A process is described for directly forming fissile UO_2 particles into a tubular shaped dispersion having a retaining matrix in which stainless steel-coated spherical UO_2 particles are extruded at low temperature with a binder directly to form a tube. The binder is removed prior to further processing in which a stainless steel cladding is intimately bonded to the tube by hot isostatic pressing. (AEC)

Properties Evaluations

Refer also to abstracts 26807, 26808, 26876, 26883, and 27826.

26892 (ORNL–4030) DETERMINATION OF THE FRACTURE TOUGHNESS OF EGCR-TYPE AGOT GRAPHITE. Corum, J. M. (Oak Ridge National Lab., Tenn.). Dec. 1966. Contract W-7405-eng-26. 45p. Dep. CFSTI.

A step was taken toward the application of fracture mechanics concepts to the design of graphite components to prevent brittle fracture. Tests were performed on notched bend specimens of EGCR-type AGOT graphite, and the results were used to determine values of G_c, the critical rate of strain-energy release. Relationships established both by the theory of elasticity and by experimental compliance testing were used. The specimens were beams with a single, lateral, artificial crack cut with a jeweler's saw. The critical rate of strain-energy release for specimens oriented parallel to the axis of extrusion of the material was found to be approximately 0.39 in.-lb/in.^{2}, and for specimens oriented transverse to the axis of extrusion the value was approximately 0.29 in.-lb/in.^{2}. G_c values based on the analytical and compliance analysis relationships were in good agreement. Results indicated that the concept of a critical strain-energy release rate being a condition for rapid crack propagation applies to graphite. However, the final proof can come only from the successful application of fracture mechanics to a component with a geometry and loading widely different from that of the laboratory specimen. (auth)

26893 (ORNL–P–3019) LOW-VOLTAGE RADIOGRAPHY AND MICRORADIOGRAPHY OF GRAPHITE. McClung, R. W. (Oak Ridge National Lab., Tenn.). [nd]. Contract W-7405-eng-26. 18p. (CONF-670605–1). Dep. CFSTI.

From 70th Annual Meeting of the American Society for Testing and Materials, Boston, Mass.

Low-voltage radiography was studied to provide optimum techniques for graphite thicknesses of less than 2 in. Significant improvements were made in image quality and sensitivity by use of an intermediate atmosphere of He, bare film, and a thin Be-window x-ray tube. Use of a high resolution photographic emulsion allows contact microradiography to be performed on miniature specimens with a resolution of one micron. (auth)

26894 (WCAP–3791–3) COMPATIBILITY OF STABILIZED HYPOSTOICHIOMETRIC URANIUM–PLUTONIUM MONOCARBIDE FUELS WITH STAINLESS STEEL. Jacoby, W. R.; Palm, R. G.; Ray, W. E. (Argonne National Lab., Ill.). Apr. 1967. Contract AT(30-1)-3791. 36p. Dep. CFSTI.

Unstabilized, Fe-stabilized, and $Cr_{23}C_6$-stabilized hypostoichiometric $(U_{0.8},Pu_{0.2})C$ fuel pellets were fabricated and characterized. Compatibility couples of stabilized and unstabilized fuel pellets versus type-304 stainless steel pellets were tested for a minimum of 1000 hours at 800°C in both He and Na environments. No fuel-cladding interactions were observed at termination of the tests on the basis of metallographic evaluation. (auth)

26895 OXIDATION OF U–C ALLOYS BY O_2: EFFECT OF THEIR CONCENTRATION. Philippot, Joseph; Moreau, Claude (Centre d'Etudes Nucleaires, Grenoble, France). Compt. Rend., Ser. C, 264: 887-90(Mar. 6, 1967). (In French).

Various U–C alloys, with C content between 5 and 7%, were oxidized by O_2 under a pressure of 150 mm at 500 to 1,000°C. The activation energy did not seem dependent on the composition of the carbide in agreement with the oxidation law. On the contrary, the velocity constant of each system was bound to the C ratio by relations analogous to those which connect them to the gas pressure. According to the linear law, it is the alloys with composition closest to stoichiometry that had the most unfavorable behavior. (tr-auth)

26896 NONDESTRUCTIVE DETERMINATION OF MECHANICAL PROPERTIES OF REFRACTORY MATERIALS. Lockyer, G. E.; Proudfoot, E. A. (Avco Space Systems Div., Lowell, Mass.). Amer. Ceram. Soc. Bull., 46: 521-6(May 1967).

Basic principles of ultrasonic and radiometric measurements were combined with knowledge of physical and chemical make up of several materials to provide measurement of density, elastic modulus, and ultimate tensile strength. Application to bulk graphite, ceramic reinforced plastic, and porous W is stressed, with limited reference to alumina, magnesia, and cast Fe. These methods may be used in materials development as well as for evaluation of finished hardware. (auth)

26897 OXIDATION STUDIES OF COMPLEX SILICIDES FOR PROTECTIVE COATINGS. Regan, R. E.; Baginski, W. A.; Krier, C. A. (Boeing Co., Seattle). Amer. Ceram. Soc. Bull., 46: 502-8(May 1967).

Oxidation tests of complex silicides performed under flowing air conditions at both atmospheric and 0.5 torr total pressures and 2800 to 2900°F demonstrated the effectiveness of alloying to improve oxidation resistance of simple refractory metal disilicides. Substantial improvements in oxidation performance at reduced pressure were afforded $NbSi_2$, $MoSi_2$, $TaSi_2$, and WSi_2 systems by additions of Cr, Ti, V, Al, and B. From a group of more than 375 compositions tested less than 10 were outstanding. A discussion of development philosophy, specimen preparation and testing methods is presented. Both steady-state and simulated service profile oxidation tests were used to compare systems. Weight change data and visual appearance records are included. (auth)

26898 ELASTIC MODULUS OF STABILIZED ZIRCONIA. Buckley, John D.; Braski, David N. (Langley Research Center, Hampton, Va.). J. Amer. Ceram. Soc., 50: 220-1(Apr. 21, 1967).

The effects of temperature, density, and amount of stabilization on the elastic modulus of highly and partially stabilized ZrO_2 were measured. Data are presented graphically. (J.R.D.)

26899 HYDRATION–DEHYDRATION CYCLING OF UO_3. Landspersky, Hanus (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Rez). Jad. Energ., 13: 12-15(Jan. 1967). (In Czech).

Hydration and dehydration of γ-UO_3 prepared by thermal decomposition of $UO_2(NO_3)_2$ was studied. After repeating hydration-dehydration cycling amorphous UO_3 was obtained with a surface area of ~10 m^2/g, as compared with that of initial γ-UO_3 of surface area of the order of 1 m^2/g. (auth)

26900 NATURE OF THE ELECTRICAL CONDUCTION TRANSIENTS OBSERVED IN CeO_2 AND Ca-DOPED CeO_2. Blumenthal, R. N.; Pinz, B. A. (Marquette Univ., Milwaukee). J. Appl. Phys., 38: 2376-83(Apr. 1967). (COO–1441–3).

The electrical conduction transients of CeO_2 and Ca-doped CeO_2 were investigated by employing a constant-current dc power source and a six-probe high-resistance input-isolated recording system. In contrast to the observations made by Kevane et al. neither voltage–time transients nor non-Ohmic behavior were observed when high-purity CeO_2 (99.9% min.) was investigated at 300 to 1000°C. Transients were observed for the high-purity CeO_2 specimen when loading due to the instrumentation occurred or when high current densities due to a small contact area were used at the contacts. A model based on electrolysis was used to explain these results. Voltage transients at constant current were observed on a CeO_2 specimen doped with 1 wt % CaO in Ar but not in O_2. These transients increased with increasing temperature in contrast to the observations made by Kevane. At 960°C in Ar potential distribution curves at several different times showed that the electrical conductivity increases with time and is larger at the negative end of the sample than at the positive end where the conductivity decreases with time initially. After longer periods of time the conductivity increased over the entire specimen. In addition the specimen exhibited a discolored region; the intensity of the discoloration decreased with increasing distance from the cathode. After reoxidation at 1000°C in air the discolored region disappeared and the weight of the specimen increased. These results were explained in terms of a model that assumed blocking of the O vacancies and O ions at the cathode and anode, respectively. The electrons were then distributed so that electroneutrality was preserved. Thus the electrical conductivity was dependent upon the distribution of the O vacancies and the O ions. After longer times the voltage transients were controlled by electrolysis. (auth)

26901 VAPORIZATION KINETICS OF CERAMIC OXIDES AT TEMPERATURES AROUND 2000°C. **Alcock, C. B.; Peleg, M. (Imperial Coll. of Science and Tech., London). Trans. Brit. Ceram. Soc., 66: 217-32(May 1967).**

The total pressures arising from free vaporization of a number of ceramic oxides were measured using the torsion–Langmuir technique. Direct measurements of the vaporization coefficients were also attempted, but the results were considered not conclusive. The oxides Al_2O_3, Yb_2O_3, Y_2O_3, Gd_2O_3, HfO_2, ThO_2, and MgO were chosen to display the effects of the complexity of the vaporization mechanism on the vaporization coefficient. It is concluded that, if the mechanism is the same in free evaporation as under equilibrium conditions, even when the process involves desorption of five atoms, e.g., Al_2O_3 and Yb_2O_3, then the coefficient is not less than 10^{-1} in any of the systems studied, and approaches unity in those cases where the mechanism is least complex. (auth)

26902 THERMAL TREATMENT OF THORIUM OXIDE GEL AT LOW TEMPERATURES. **Mikhail, R. Sh. (Clarkson Coll. of Tech., Potsdam, N. Y.); Fahim, R. B. J. Appl. Chem. (London), 17: 147-50(May 1967).**

Investigations were carried out on the variation of the specific surface area of ThO_2 gel upon thermal treatment in air at 35 to 1000°C. The specific surface areas and pore volumes of the parent gel and its various dehydration products were calculated from the adsorption of N_2 at the temperature of liquid N_2. The results obtained were compared with those measured from the adsorption of water, methanol and cyclohexane. The adsorbates were chosen to possess different molar volumes and polarities. Water was used because of its known ability to interact with ThO_2, and the extent to which this interaction limited its use was tested. X-ray and thermogravimetric analyses revealed structural changes after thermal treatment. The gel was amorphous to x rays at temperatures up to 300°C, and it then crystallised to the cubic ThO_2. Below 300°C the surface area decreased continuously, probably by a mechanism of diffusion and material transport from wider pores to fill fine pores (surface annealing). This was followed at higher temperatures by a crystallisation (activation) stage, and finally, by a sintering or crystal growth stage. (auth)

26903 STUDY OF $UC_{1-x}O_x$. III. Namba, Shingo; Imoto, Shosuke; Sano, Tadao (Osaka Univ.). Nippon Genshiryoku Gakkaishi, 9: 132-8(Mar. 1967). (In Japanese).

The heat formation and the heat capacity of $UC_{1-x}O_x$ (uranium oxycarbide) were measured for the values of x from 0 to 0.84, from which the standard heat of formation of $UC_{1-x}O_x$ was calculated. The heat of formation at the reaction temperature of 640°K was determined by measuring the heat of combustion of $UC_{1-x}O_x$ using differential thermal analysis, resulting in $\Delta H^\circ_{640} = -21.3 - 108.5x$ kcal/mole. Measurements of heat capacity were made at room temperature to about 640°K. The result was $C_p = 13.95 + 0.32 \times 10^{-3}\ T - 1.91 \times 10^5 T^{-2}$. The standard heat of formation of $UC_{1-x}O_x$, estimated from the heat of formation at 640°K and the heat capacity measured at 298 to 640°K was $\Delta H^0_{298.16} = -21.7 - 108.5x$ kcal/mole. (auth)

26904 A REVIEW OF THE RECENT LITERATURE ON THE DIELECTRIC PROPERTIES AND SINTERING OF ALUMINA. **Perry, G. S. (Atomic Weapons Research Establishment, Aldermaston, Eng.). J. Mater. Sci., 1: 186-98(May 1966).**

A review of recent literature (168 references) concerned with the application of polycrystalline sintered Al_2O_3 to radome problems is presented. The shape, design, and material of construction depends on environmental conditions. In general, the material must be homogeneous with respect to permittivity and dielectric loss at all temperatures. Effects of impurities on dielectric properties are considered. The use of high-temperature electroceramics in applications other than the limited fields of radomes and insulation is also considered. One of these is in the manufacture of windows for high power klystrons. In studies made of the failure of klystron windows, the major cause of failure (100-KV electron bombardment) was internal damage, and the postulated mechanism is gas discharge within pores in the ceramic. Sintering and fabrication of Al_2O_3 are also considered. (BBB)

26905 THE FATIGUE AND TENSILE FRACTURE OF TD–NICKEL. Ham, R. K.; Wayman, M. L. (McMaster Univ., Hamilton, Ont.). Trans. Met. Soc. AIME, 239: 721-5(May 1967).

TD-Nickel has been broken in tension and in fatigue at room temperature. Rod specimens failed in tension by necking, with axial cracks attributed to voids elongated in the extrusion direction. Fatigue specimens failed in shear. Thin-film electron microscopy showed that the subgrain structure of TD-Nickel was very stable, and that particle-matrix detachment was very difficult, in tension and fatigue. TD-Nickel softened slightly during fatigue but had a high fatigue ratio. Fractography suggested that Stage I fatigue crack propagation is greatly extended in TD-Nickel. (auth)

26906 INFLUENCE OF A FINE DISPERSION ON THE CLEAVAGE STRENGTH OF IRON. Hahn, G. T.; Rosenfield, A. R. (Battelle Memorial Inst., Columbus, Ohio). Trans. Met. Soc. AIME, 239: 668-74(May 1967).

The effects of adding 0.025 volume fraction of uniformly dispersed ThO_2 particles to iron have been examined. The two-phase alloy is shown to have a lower transition temperature and higher cleavage stress than either the base metal or a solid-solution alloy. Enhanced cleavage resistance is thought to be a consequence of particles limiting the effective slip distance of dislocations and thus the ability of pile-ups to act as stress concentrations. Further calculations predict that the highest cleavage strengths are attained with uniform dispersions, where the particle size is kept small and the volume fraction is relatively large. (auth)

26907 THE EFFECT OF THERMOMECHANICAL TREATMENTS ON THE ELASTIC STORED ENERGY IN TD NICKEL. Grierson, R.; Bonis, L. J. (Ilikon Corp., Natick, Mass.). Trans. Met. Soc. AIME, 239: 622-6(May 1967).

The high-temperature strength of TD nickel has been observed to be dependent upon the previous thermal and mechanical history of the material. Variations in both the level and the anisotropy of strength have been observed. These variations are correlated with the storing of annealing resistant elastic strain energy in the matrix of the TD nickel. An X-ray line-broadening technique is used to measure the matrix elastic strain. (auth)

26908 ROOM TEMPERATURE ELASTIC CONSTANTS OF SINGLE CRYSTAL U_4O_9. De Batist, R. (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). Mater. Res. Stand., 1: 75-81(Oct. 1966).

Measurements are reported for the elastic constants of single crystal U_4O_9, made on the same specimens used for a determination of the elastic constants of UO_2, after controlled oxidation to U_4O_9. Two single crystals were used, one grown from vapor and the other from the melt. The elastic constants were obtained from the velocity of ultrasonic waves. The room-temperature elastic constants of single crystal U_4O_9 measured by using the pulse echo technique were: $C_{11} = 3.19 \times 10^{12}$, $C_{12} = 1.21 \times 10^{12}$, and $C_{44} = 0.41 \times 10^{12}$ d cm^{-2}. The lattice energy for both UO_2 and U_4O_9 was calculated from the compressibility; it was shown that the exponent describing the strength of the interatomic potential in the Born model is smaller than the values usually found in the literature. The following other elastic parameters found for U_4O_9 were: elastic compliances: $s_{11} = 0.396 \times 10^{-12}$, $s_{12} = -0.109 \times 10^{-12}$, and $s_{44} = 2.44 \times 10^{-12}$ cm^2/d; anisotropy: A = 0.41; Poisson's ratio's: $\sigma_{100} = 0.275$ and $\sigma_{111} = 0.398$; bulk modulus: $B = 1.87 \times 10^{12}$ d/cm^2; compressibility: $\beta = 0.535 \times 10^{-12}$ cm^2/d; Young's modulus: Voigt average: $E_V = 1.73 \times 10^{12}$ d/cm^2 and Reuss average: $E_R = 1.47 \times 10^{12}$ d/cm^2; shear modulus: Voigt average: $G_V = 0.64 \times 10^{12}$ d/cm^2 and Reuss average: $G_R = 0.54 \times 10^{12}$ d/cm^2. (BBB)

26909 DEFORMATION MECHANISMS IN THORIA AT ELEVATED TEMPERATURES. **Poteat, Laurence Ernest. Raleigh, N. C., North Carolina State of the Univ. of North Carolina, 1966. 91p.**

Thesis.

The deformation of ThO_2 was investigated over a wide range of strain rates and temperatures. Specimens of ThO_2 were prepared by isostatically pressing and sintering. Composition, grain size, and test specimen size were kept constant. The density of the specimens fell into two groups averaging 97.3 and 98.4% of theoretical density. Various strain rates were evaluated as functions of temperature, stress, and density and these results were correlated with the microstructures of the deformed specimens. Mechanical strengths were found to be very sensitive to density. Values of compressive strength obtained were considerably higher than previously published values. The activation energy for creep deformation of ThO_2 was found to be 112 kcal/mole. The results indicated that the deformation mechanism depends on the strain rate and the temperature. At a constant temperature (1770°C) three mechanisms were found to be possible, the operative mechanism depending on strain rate. These mechanisms were grain boundary shearing by diffusion, plastic flow by dislocation motion, and brittle failure. A model has been proposed for the mechanism of grain boundary diffusional creep. (auth)

Structure and Phase Studies

Refer also to abstract 26876.

26910 MICROSTRUCTURE OF SINGLE-CRYSTAL TITANIUM CARBIDE. Vahldiek, F. W. (Air Force Materials Lab., Wright-Patterson AFB, Ohio). J. Less-Common Metals, 12: 429-40 (June 1967).

Single crystals of TiC studied were found to be $TiC_{0.95}$ by chemical and electron-probe analyses. Cleaving along the (001), (100), and (110) planes produced slip of the {111} ⟨110⟩ type. Electron transmission revealed growth twins in the (100) plane in the [103] direction. Thermal etching by annealing from 1800 to 2100°C in vacuum brought out stacking faults sometimes associated with dislocations in the (001) and (100) planes, as determined by optical and electron-optical microscopy. During annealing a compositional change from $TiC_{0.95}$ to $TiC_{0.92}$, associated with a random formation of free C as graphite and Ti_3O_5, was determined by chemical, electron-probe, and electron-diffraction analyses. Electron-microprobe traverses across the fault network did not reveal changes in impurities and composition compared to the matrix, determined to be $TiC_{0.92}$. (auth)

26911 INVESTIGATION OF ZIRCONIUM ANHYDRIDE PACKING DURING HOT PRESSING. Kainarskii, I. S.; Alekseenko, L. S.; Degtyareva, E. V. (Ukrainian Scientific-Research Inst. of Refractory Materials, Kharkov). Porosh. Met., Akad. Nauk Ukr. SSR, No. 4, 24-9(Apr. 1967). (In Russian).

The packing of ZrO_2 with some additives during hot pressing was investigated. It is shown that introduction of additives, which form with ZrO_2 the solid solutions (CaO, MgO, Y_2O_3, CeO_2) during the process of hot pressing, ensures obtaining samples with the volume weight close to theoretical density; the additive amount has an optimum, above which the density of hot-pressed samples decreases. The additives, which do not form solid solutions with ZrO_2, either do not effect hot-pressed sample density (Ti), or reduce it (SiO_2). (auth)

26912 PHYSICAL PROPERTIES OF SOLID SOLUTIONS OF THE SYSTEM NbC–MoC. Denbnovetskaya, E. N. (Inst. of Problems in Materials, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR, No. 4, 57-60(Apr. 1967). (In Russian).

Concentration dependence of the investigated properties of solid solutions of the system $NbC-Mo_3C_2$ testifies to the changes in the electron structure of the solid solution at the increase of molybdenum carbide content. (auth)

26913 CONDENSED PHASE RELATIONS IN THE SYSTEMS ZrO_2–WO_2–WO_3 AND HfO_2–WO_2–WO_3. Chang, Luke L. Y.; Scroger, M. G.; Phillips, Bert (Tem-Pres Research, Inc., State College, Pa.). J. Amer. Ceram. Soc., 50: 211-15(Apr. 21, 1967).

Phase relations for the systems $ZrO_2-WO_2-WO_3$ and $HfO_2-WO_2-WO_3$ at 1000 to 1700°C were determined by the quenching technique using sealed sample containers. In the system ZrO_2-WO_3, 1 : 2 compound, ZrW_2O_8 forms, having a cubic structure with a = 9.159 Å. The ZrW_2O_8 melts incongruently at 1257 ± 3°C to ZrO_2 and liquid and has a lower limit of stability at 1105°C, below which ZrO_2 and WO_3 coexist in equilibrium. One eutectic and one peritectic were established: at 1231 ± 3°C and 74 mole % WO_3, respectively. Two invariant points were determined: ZrO_2, WO_2, W, and liquid are in equilibrium at 1430 ± 5°C and 76 mole % WO_2, whereas WO_2, $W_{18}O_{49}$, W, and liquid coexist at 1530 ± 5°C and 89 mole % WO_2. Equilibrium relations in the system $ZrO_2-WO_2-WO_3$ were investigated at four temperatures. At 1200°C, a cubic phase with composition near $W_{20}O_{58}$ was found; it exists in equilibrium with ZrO_2, $W_{18}O_{49}$, $W_{20}O_{58}$, and WO_3. As the temperature increases, the liquid formed along the ZrO_2-WO_3 join extends into the ternary system, crosses the join $ZrO_2-W_{20}O_{58}$ at 1300°C, and crosses the join $ZrO_2-W_{18}O_{49}$ at 1400°C. The cubic phase can take more Zr into its solid solution at 1300 than at 1200°C. At 1500°C, the system can no longer be treated as a simple ternary oxide system because of the presence of metallic W, and equilibrium relations are presented on the basis of the system ZrO_2-W-WO_3. Phase equilibrium relations in the systems HfO_2-WO_3, HfO_2-WO_2, and $HfO_2-WO_2-WO_3$ in the temperature ranges studied are much like those in the corresponding Zr system. (auth)

26914 CRYSTAL STRUCTURE OF $ZrTiO_4$. Newnham, R. E. (Pennsylvania State Univ., University Park). J. Amer. Ceram. Soc., 50: 216(Apr. 21, 1967).

The O_2 atoms in crystals form a distorted hexagonal close-packed array with Ti and Zr occupying half of the octahedral interstices. Each metal ion is bonded to six O_2 atoms at an average distance of 2.04 Å; four are at 1.94 Å and two more at 2.23 Å. (J.R.D.)

26915 CREEP-ELECTRICAL CONDUCTIVITY CORRELATIONS IN POLYCRYSTALLINE BERYLLIUM OXIDE. Cline, Carl F.; Newkirk, Herbert W.; Barmore, Willis L.; Vandervoort, Richard R. (Univ. of California, Livermore). J. Amer. Ceram. Soc., 50: 221-2(Apr. 21, 1967). (UCRL–70176).

An investigation was conducted to determine if motion of the Be ion is rate controlling during creep of polycrystalline BeO. It is concluded that if the electrical conductivity is insensitive to stress, then diffusion of the Be ion apparently does not govern the rate of creep. (J.R.D.)

26916 IDEAL SOLUTION BEHAVIOR AND HEATS OF FUSION FROM THE UO_2–PuO_2 PHASE DIAGRAM. Epstein, L. F. (General Electric Co., Pleasanton, Calif.). J. Nucl. Mater., 22: 340-9(1967).

Under equilibrium conditions, the binary system UO_2-PuO_2 forms a continuous series of solid solutions, and has the familiar lens-shaped phase diagram, without the previously reported maximum in the melting point. The curves are reproduced with great accuracy by using the ideal solution relations and values of the heats of fusion for the pure constituents obtained from the two-component melting point data. The Epstein and Howland approximation, that the entropy of fusion of metals and oxides is equal to R per atom, is subjected to a rigorous statistical evaluation by writing $\Delta H_i/T_i = \alpha_i N_i R$. If the rule were exact, α_i would be unity. For both the 56 elements and the 46 oxides for which reliable heat of fusion data are available, it was found that the mean value of the deviation constant is $\overline{\alpha} = 1.18 \pm 0.32$. For UO_2 and PuO_2, the values are $\alpha_{UO_2} = 1.140 \pm 0.001$, $\alpha_{PuO_2} = 1.057 \pm 0.001$, and the corresponding heats of fusion are $\Delta H_{UO_2} = 21{,}200$ cal/mole, and $\Delta H_{PuO_2} = 16{,}800$ cal/mole, with an estimated uncertainty of ±1300 cal/mole. Using these constants, the Lyon and Baily phase diagram can be derived theoretically, with deviations no greater than the experimental uncertainties. (auth)

26917 SOLID SOLUTIONS IN THE SYSTEM $SrTiO_3$–(La_2O_3:$3TiO_2$). Tien, T. Y. (Westinghouse Research Labs., Pittsburgh); Hummel, F. A. Trans. Brit. Ceram. Soc., 66: 233-45(May 1967).

The system $SrTiO_3-La_2(TiO_3)_3$ was studied by x-ray diffraction. Cubic perovskite solid solutions were formed in the system from $SrTiO_3$ to a composition containing 94 mole % $La_2(TiO_3)_3$. The superstructure lines which were observed at compositions containing more than 70 mole % $La_2(TiO_3)_3$ could be indexed with a double cubic cell edge. True density and x-ray intensity measurements indicated that these solid solutions contain cation vacancies in the strontium sites of the lattice. The number of vacancies corresponds to the amount of $La_2(TiO_3)_3$ introduced in the solid solution. (auth)

26918 RARE GAS DIFFUSION IN NONSTOICHIOMETRIC ZIRCONIUM CARBIDE. Auskern, A. (Brookhaven National Lab., Upton, N. Y.). Contract AT(30-2)-Gen-16. J. Nucl. Mater., 22: 257-68(1967). (BNL–10595).

The release of tracer amounts of ^{133}Xe from ZrC powder was measured over a range of powder compositions. Release is for the most part diffusion controlled. The activation energy and D_0 vary greatly with C content. For low C material E_D is less than 80 kcal/mole; E_D increases to 190 kcal/mole for $ZrC_{0.83}$. The activation energy for $ZrC_{0.58}$ appears consistent with estimates based on metallic systems, while for higher carbides the metallic model underestimates the activation energies. A modification of the metallic activation energy model, based on diffusion in covalent systems, is suggested. (auth)

26919 SOLID–LIQUID PHASE DIAGRAM FOR THE UO_2–PuO_2 SYSTEM. Lyon, W. L. (General Electric Co., Pleasanton, Calif.). Contract AT(04-3)-189. J. Nucl. Mater., 22: 332-9 (1967).

The liquidus and solidus were experimentally determined for the UO_2-PuO_2 system by a thermal arrest method. The phase diagram is typical of a binary pair with complete solid solution and without maximum or minimum. A melting point of 2840 ± 20°C was observed for UO_2, and a melting point of 2390 ± 20°C was observed for PuO_2. Calculated theoretical liquidus and solidus curves exhibit good agreement with the experimental values found. (auth)

26920 TERNARY SYSTEM W–Cr–C. Gladyshevskii, E. I.; Telegus, V. S.; Fedorov, T. F.; Kuz'ma, Yu. B. Izv. Akad. Nauk SSSR, Metal., No. 1, 190-3(Jan.-Feb. 1967). (In Russian).

The phase diagram of the system W–Cr–C was investigated. The specimens were annealed in vacuum at 1400°C for 100 hours. The phase diagram was constructed on the basis of chemical, x-ray, and microstructural analysis. It was found that the lattice parameter of the carbide (W,Cr)C was very close to the extrapolated value for the solid solutions of W in ZrC. The phase (W,Cr)C may represent a solid solution of W in CrC. (ATD)

26921 PHASE COMPOSITION OF ZrO_2–ZrC AND ZrO_2–TiC ALLOYS. Kotlyar, E. E.; Kosolapova, T. Ya.; Nazarchuk, T. N. Izv. Akad. Nauk SSSR, Metal., No. 1, 201-4(Jan.-Feb. 1967). (In Russian).

The solubility of TiC and ZrC, and TiO_2 and ZrO_2 in solutions of HNO_3, aqua regia, H_2SO_4, and other acids was investigated, and a method of determining the phase composition of ZrO_2–ZrC and ZrO_2–TiC systems was worked out. It was found that TiC and ZrC dissolve in mixtures of $H_2SO_4 + (NH_4)_2SO_2O_8$ and $H_2SO_4 + H_2O_2$. ZrO_2 and TiO_2 practically do not dissolve in the latter mixture. A study of interaction between ZrO_2 and ZrC and TiC in the range from 1000 to 2200°C showed that the interaction between cubic ZrO_2 and ZrC begins at 1700°C, and between TiC and ZrO_2, at 1300°C. A series of ZrO–ZrC–ZrO–TiC solid solutions is formed in these reactions. (ATD)

26922 CONSTITUTION OF A PORTION OF THE NIOBIUM (COLUMBIUM)–NITROGEN SYSTEM. Guard, R. W.; Savage, J. W.; Swarthout, D. G. (North American Aviation Science Center, Thousand Oaks, Calif.). Trans. Met. Soc. AIME, 239: 643-9(May 1967).

The Nb–N constitution diagram has been examined from 1100 to 1450°C at 1 atm N_2 pressure. On the basis of our work plus that of Brauer and coworkers the stable nitride phases are: α solid solution, basic niobium with nitrogen contained interstitially; β NbN_x, $x = 0.39$ to 0.45, hexagonal; γ NbN_x, $x = 0.75$ to 0.80, tetragonal; δ NbN_x, $x = 0.88$ to 0.91, cubic; ϵ NbN_x, $x = 0.92$ to 1.00, hexagonal. In addition, a metastable transition phase δ' has been observed and occurs only during the transition $\delta \rightarrow \epsilon$. δ' NbN has these distinguishing parameters: NbN_x, $x = 0.96$, hexagonal. The high-temperature phase fields in the system are governed by two reactions: $\delta \rightleftharpoons \gamma + \epsilon$, a eutectoid reaction occurring at 1270 ± 20°C; $\delta + N_2 \rightleftharpoons \epsilon$, a 2 on 1 reaction occurring at 1370 ± 20°C. (auth)

26923 INVESTIGATIONS ABOUT CRYSTALLINE TRANSFORMATION IN RARE EARTHS SESQUIOXIDES AT HIGH TEMPERATURES. Foex, Marc; Traverse, Jean-Pierre (CNRS, Mont-Louis, France). Rev. Int. Hautes Temp. Refract., 3: 429-53(Oct.-Dec. 1966). (In French).

Results are presented of a high-temperature study of crystalline transformations in rare earth sesquioxides. New crystalline forms of the sesquioxides, stable only at high temperatures, were detected and identified, one hexagonal, and another cubic. These were in addition to the classical varieties A, B, and C. Debye-Scherrer spectrums, parameters of the hexagonal, monoclinic, and cubic C forms, and results of differential thermal analyses are shown. (P.G.C.)

26924 CRYSTAL STRUCTURE OF ZIRCONIUM(IV) BOROHYDRIDE (AT –160°). Bird, P. H.; Churchill, M. R. (Harvard Univ., Cambridge, Mass.). Chem. Commun., No. 8, 403(1967).

A complete three-dimensional single crystal x-ray structural analysis of $Zr(BH_4)_4$ is reported. It was found that the compound crystallises in the cubic space group $\underline{P}\,\bar{4}3\,\underline{m}$ (No. 215) with $\underline{a} = 5.86$ Å and Z = 1. Provided there is no disorder the molecule must possess the full $\underline{T}_{\underline{d}}(\bar{4}3\underline{m})$ symmetry of the space group. The refined structural analysis confirmed the $\underline{T}_{\underline{d}}$ symmetry. The Zr atom is tetrahedrally surrounded by four crystallographically equivalent B-atoms (Zr . . . B = 2.34 ± 0.03 Å), the symmetry of the space group requiring that each Zr . . . B vector is coincident with a C_3 axis. A single terminal hydrogen atom was located on this threefold axis (Zr . . . B–H = 180°, B–H = 1.2 ± 0.4 Å). It appears that there are three bridging H-atoms associated with each borohydride ligand. Thus the Zr atom is surrounded by twelve bridging H-atoms. (UK)

Radiation Effects

Refer also to abstract 27251.

26925 (BMI–1799) AN EVALUATION OF UC–PuC FOR SODIUM-COOLED FAST REACTORS. Wullaert, Richard A.; Fackelmann, Joseph M.; Chubb, Walston (Battelle Memorial Inst., Columbus, Ohio). Apr. 13, 1967. Contract W-7405-eng-92. 30p. Dep. CFSTI.

Irradiation data reported in the literature through October, 1966, for UC and UC–PuC were analyzed with respect to the effects of temperature, burnup, composition, initial density, and other factors upon swelling and gas release. The relationship between temperature and either swelling or gas release appears to be exponential. Below 1000°C, the relationship between swelling and burnup is linear. Compositions containing free U metal show rates of swelling and gas release which increase in proportion to the amount of free metal. In the range of 90 to 100% of theoretical density, the available data show little or no effect of initial porosity upon the swelling or gas-release characteristics of UC and UC–PuC. The data, which were classified primarily on the basis of maximum centerline temperatures, show no additional effect of burnup rate on swelling. Compatibility data of particular interest to Na-cooled fast reactors are summarized. Data are presented showing that the mechanical effects of the reaction of UC with steam above approximately 150°C are different from the effects of the reaction of UC with water below this temperature. (auth)

26926 (SC-DC–67-1789(Rev.)) THERMAL-NEUTRON-INDUCED-DEFECTS IN n-TYPE CADMIUM TELLURIDE. Barnes, Charles; Kikuchi, Chihiro (Michigan Univ., Ann Arbor). May 1967. Contract AT(29-1)-789. 28p. (CONF-670602–9). DTIE.

From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif.

During thermal neutron irradiation, Frenkel defects are produced in CdTe due to the recoil of ^{114}Cd following radiative capture by ^{113}Cd. The properties of these defects can be studied by measuring the Hall effect and electrical conductivity before and after successive irradiations. The results indicate that the Cd vacancy is responsible for electron removal in n-type CdTe and that the introduction rate of Cd vacancies is strongly influenced by annealing during irradiation. (auth)

26927 INFLUENCE OF NEUTRON IRRADIATION ON IONIC MOBILITY IN CUBIC ZIRCONIA. Harrop, P. J.; Wanklyn, J. N. (Atomic Energy Research Establishment, Harwell, Eng.). J. Nucl. Mater., 22: 350-1(1967).

Results of an investigation of radioinduced corrosion of Zr alloys having oxide films indicate that an increase in the mobility of the vacancies in the oxide film, following a reduction of the activation energy for diffusion enhances corrosion of the base metals. Data are included for use in comparing the electric conductivity of irradiated and unirradiated samples of stabilized ZrO_2. (J.R.D.)

26928 MICROSTRUCTURE OF IRRADIATED URANIUM DIOXIDE. Ishii, Bumpei; Seki, Yoshinobu (Mitsubishi Atomic Power Industries, Inc., Omiya, Japan). J. Nucl. Sci. Technol. (Tokyo), 4: 143-8(Mar. 1967).

Sintered UO_2 pellets irradiated at high temperature to a burnup of 2,700 MWd/t-UO_2 were studied by replica electron microscopy. The as-irradiated pellet surfaces were covered by a thin layer easily soluble in dilute acid. This layer apparently was deposited as a sublimate during irradiation. The etched surfaces of the irradiated specimens were uniformly dispersed with flat circular domes about 1 μ in diameter, constituted of precipitates resistant to etching solution, apparently a mixture of fission products and UO_2. On the surface of each dome were several "sprout" precipitates 0.1 to 0.3 μ in diameter, and almost immune to chemical etchant. (auth)

Plastics and Other Materials

Refer also to abstracts 25816, 26125, and 26761.

26929 (SC-DR–67-81) PROCESSING CONDITIONS AND THEIR EFFECTS ON THE DIMENSIONAL BEHAVIOR OF PRECISION MOLDINGS. IV. GLASS-FILLED CELCON PARTS. Thoma, P. J. (Sandia Corp., Albuquerque, N. Mex.); Roebuck, C. E. (Bendix Corp., Kansas City, Mo.). Apr. 1967. Contract AT(29-1)-789. 78p. Dep. CFSTI.

Data regarding dimensional behavior of 30% glass-filled Celcon molding material as a function of five independent variables (mold temperature, melt temperature, injection pressure, press closed time, and annealing time) and various environmental conditioning procedures are presented. Mold temperature and annealing procedures were found to be significant in producing dimensionally stable parts. Filled material exhibited less resistance to flow than unfilled Celcon, indicating that the filler caused an increase in flow at lower pressures. Optimal molding conditions for all variables studied were determined statistically. (auth)

26930 ENERGY SPECTRUM OF RADIATION DISTURBANCES IN SINGLE SILICON CRYSTALS. Sevchenko, A. N.; Tkachev, V. D.; Lugakov, P. F. (Belorussian State Univ., Minsk). Dokl. Akad. Nauk SSSR, 169: 562-4(July 21, 1966). (In Russian).

Energy spectra of levels appearing in Si monocrystals irradiated by various integral fluxes of fast electrons, neutrons, and γ quanta were studied. The 1-MeV electron fluxes consisted of 10^{13} to 10^{18} cm^{-2} fast neutrons 10^{12} to 10^{19} cm^{-2} and γ quanta 10^{15} to 10^{19} cm^{-2} from the ^{60}Co source. The initial n- and p-type Si had a specific resistance from 0.03 to 150 ohm·cm which contained chemical impurities contributing deep energy levels into the forbidden zone in concentration not exceeding 5×10^{12} cm^{-3}. The conductivity, Hall coefficient, and spectral distribution of photoconductivity signals were studied using crystals irradiated with various hard radiation fluxes and in non-irradiated crystals. (R.V.J.)

26931 EFFECT OF RADIATION ON ADHESION OF POLYMER COATINGS ON ALUMINUM. Kabanov, V. Ya.; Grozinskaya, Z. P.; Zubov, P. I.; Spitsyn, Vikt. I. (Inst. of Physical Chemistry, Moscow). Dokl. Akad. Nauk SSSR, 169: 146-9 (July 1, 1966). (In Russian).

A comparative study was made on adhesion of 500 to 600-μ thick epoxy, polyester, perchloroethylene, and polyurethan coatings on aluminum foil before and after irradiation at a low (from ^{60}Co source) or high (~10^4 rad/sec from a linear accelerator) dose rate of ionizing radiation. A stripping method was used to evaluate adhesion. Energy of adhesion was also determined during irradiation with a high-intensity electron beam (from the linear accelerator). An increase in adhesion of all coatings studied was noted after prolonged irradiation at a low dose rate (163 rad/sec), in air or vacuum, together with an increase in rigidity and brittleness of all but the polyurethan coatings. Epoxy coatings exhibited the most notable increase in adhesion. The initial increase in adhesion was explained as the result of radioinduced formation of polar groups, e.g., OH, C=O, and after hardening of the coatings. In opposition to polyethylene, the energy of adhesion of other coatings was higher under the electron beam than before irradiation. The highest difference in adhesion was noted for epoxy coatings, the lowest for polyurethan coatings. This increase in adhesion was reversible in case of a short-time irradiation, irreversible in case of a longer exposure (higher radiation dose absorbed) to the electron beam. The role of chemical changes in polymers and relaxation processes is discussed to explain the increase in adhesion in polymers exposed to the electron beam. Duration of the exposure to radiation and the presence of oxygen in the coatings' composition were the most important factors contributing to increase in adhesion. (ATD)

26932 EFFECTS OF NUCLEAR RADIATIONS ON POLYMERS. van de Voorde, Marcel (CERN, Geneva). Ind. At., 11: Nos. 3-4, 61-70(1967). (In French).

The effects of nuclear radiation on polymers, as well as its influence on their chemical, mechanical, electrical, and optical properties, are considered. Certain applications in the field of accelerators are given in particular for vacuum chambers and insulators. The damages currently caused by radiation in the CERN proton synchrotron and those that may be anticipated in the future are described. (auth)

PHYSICS (GENERAL)

Astrophysics

Refer also to abstracts 26000, 26992–26994, 27024, and 27265–27268.

26933 (AD–643814) ON SOME PROPERTIES OF SOLAR STORM BURSTS IN THE 200 MC/S REGION. Report No. 18. Eckhoff, Hans Kr. (Oslo Univ. (Norway). Institutt for Teoretisk Astrofysikk). May 1966. 30p. CFSTI $3.00 cy, $0.65 mn.

More than 4000 storm bursts recorded with the swept-frequency receiver at Harestua during an intense noise storm occurring in August, 1961, were analyzed. From the recordings three periods were selected for a close examination. During one of these a very remarkable change in burst duration took place. The abnormal conditions lasted for some minutes and the period is henceforth referred to as the "flash period". The mean "total duration" of the storm bursts occurring outside the flash period was found to be 0.43 seconds and the mean "total bandwidth" amounted to 5.6 Mc. During the flash period the mean total duration of the bursts decreased to 0.22 seconds and also the spread in burst durations diminished. No change in the distribution of burst bandwidths was found during the flash period. Frequency drift is discussed in connection with "flash bursts" and ordinary type-I bursts. Many complex bursts were studied by means of an isodensitometer. As a result of this a maximum duration of 0.8 seconds was established for the bursts in the material. (auth)

26934 (NP–16738) NEUTRINOS IN SUPERDENSE MATTER. V. MOTION IN VOLKOFF SPHERES. Kuchowicz, Bronislaw (Warsaw Univ. (Poland). Dept. of Radiochemistry). Nov. 1966. 20p. Dep.

In preceding papers the neutrino motion in a fluid sphere described by the Schwarzschild internal solution has been investigated. A sphere with constant mass density may be, however, described not only by the Schwarzschild internal solution but also by some solution with singularity. For these so called Volkoff spheres the neutrino motion is studied. Contrary to the behavior in the field of the internal Schwarzschild solution, the central regions of the sphere are now admitted to neutrino motion. (auth)

26935 (TID–23760, pp 33-48) RADIO ASTRONOMY. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics).

Brief results of research are presented on each of the following: Haystack–Millstone OH interferometer, Millstone–Agassiz OH interferometer, K-band spectrum measurements of the sun, inference of atmospheric attenuation near 61.15 GHz from balloon flight results, and observations from microwave emission from atmospheric oxygen: balloon results, summer 1965. (M.O.W.)

26936 (TID–23760, pp 69-73) GRAVITATION RESEARCH. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics).

A brief discussion is presented of the experimental investigation on the gravitational interaction. In addition, measurements were made of metastable versus ground-state electron exchange cross sections for helium and neon. (M.O.W.)

26937 A STUDY OF PLANETARY NEBULA NGC 1514. I. THE DOUBLE-STAR HYPOTHESIS FOR THE PLANETARY NUCLEUS BASED ON PHOTOELECTRIC PHOTOMETRY. Kohoutek, L. (Astronomical Inst., Prague). Bull. Astron. Inst. Czech., 18: 103-13(1967).

The central star of planetary nebula NGC 1514 differs markedly from the other nuclei of planetary nebulae by its high brightness and late-type spectrum. Its photoelectric measurements show an ultraviolet excess of -0.4^m, its ionizing radiation reaches to only $\frac{1}{5}$ of the nebular radius, and, on the contrary, the radiation of the highly excited nebula gives an effective temperature of the nucleus five times that corresponding to its observed spectral type. Attempts were made to explain these discrepancies by the presence of a second component in the central star, the nucleus proper of the the nebula. The preliminary model of NGC 1514 gives the following parameters of the nebula: distance $r = 480$ pc, $A_V = 2.0^m$, $M_n = +0.2$, linear diameter $D = 0.30$ pc, electron density of the inner and outer envelope $N_e = 290\ \text{cm}^{-3}$, $(N_e) = 140\ \text{cm}^{-3}$ respectively, hydrogen mass of the inner and outer envelope $M_H = 0.10\ M_\odot$, $(M_H) = 0.07\ M_\odot$ respectively, total mass $0.18\ M_\odot$, optical thickness of the primary envelope $\tau_1 = 0.085$. Parameters of the central star: physical double-star A0III (A component) + blue sd (X component), $M_{V,A} = -0.7$, $M_{bol,A} = -1.1$, $T_{*,A} = 10800°K$, $R_{*,A} = 4.1\ R_\odot$; $M_{V,X} = +1.2$, $M_{bol,X} = -4.0$, $T_{*,X} = 60{,}000°K$, $R_{*,X} = 0.45\ R_\odot$. The definitive model will be designed after further observational data have been obtained. (auth)

26938 ORIGIN OF HYPERSTHENE CHONDRITES: AGES AND SHOCK EFFECTS OF BLACK CHONDRITES. Heymann, Dieter (Univ. of Chicago). Contract AT(11-1)-382. Icarus, 6: 189-221(Mar. 1967). (COO-382-63; EFINS-66-62).

In an attempt to establish the cause of the short gas-retention ages among the hypersthene chondrites, two lines of evidence were examined. (1) Rare-gas contents were determined in 20 black hypersthene chondrites by mass spectrometry. (2) Symptoms of shock and reheating were studied by x-ray diffraction analysis in olivine from 40 chondrites, including 15 black ones; and by metallographic techniques in 20 chondrites, including 18 black ones. On the basis of the results, it was concluded that an earlier suggestion by Anders that black chondrites are severely shocked is essentially correct. At least 15 black hypersthene chondrites seem to have suffered shocks ranging from a few hundred kilobars up to perhaps 1 or 1.5 Mbar. The shock apparently transformed olivine to a fine-grained polycrystalline state; the crystallites show a range of preferred orientation. From the cosmogenic $^3He/^{21}Ne$ ratios, it was concluded that black hypersthene chondrites generally suffered He losses of approximately 20 to 25% at a late stage, during the cosmic-ray bombardment era. The corrected ^3He and ^4He contents of 12 black hypersthene chondrites define an isochron of 520 ± 60 Myr with a $(^4He/^3He)$ production ratio of 5.2 ± 0.3. A review of literature data showed that on the basis of their He contents, one-third of the hypersthene chondrites seem to have been definitely involved in the 520 Myr event, another one-third probably so. The large proportion of concordant K–Ar ages among the former strongly supports the contention that the 520 Myr date represents a genuine out-gassing event. These results bear out earlier conclusions by Anders that most, if not all the hypersthenes were on one or at most two parent bodies until relatively late in their history; and by Kirsten, Krankowsky, and Zähringer that short gas-retention ages of chondrites have arisen from collisional reheating of cold parent objects. The 520 Myr collision seems to have involved the breakup of a parent asteroid of the hypersthene chondrites. The well-known paradox of the cosmic-ray exposure ages being much shorter $(0.03 \simeq 60$ Myr) can be solved by the hypothesis that kilometer-sized fragments of the parent asteroid were deflected by Mars into Earth-crossing orbits on a time scale of $\sim 10^9$ yr. Chondrites spalled off from such fragments by secondary collisions have lifetimes against planetary capture of 10^6 to 10^7 yr. The destruction lifetime of chondrites in the asteroid belt can be increased from 10^7 to $\sim 10^8$ yr with a 10-fold reduction on the cross-section requirement. (auth)

26939 RADIO SOURCES AND PECULIAR GALAXIES. Wagoner, R. V. (California Inst. of Tech., Pasadena). Nature, 214: 766-9(May 20, 1967).

In the present state of ignorance concerning the fundamental nature of radio sources, clues might be obtained from a study of their distribution over the sky. It has been claimed that radio sources have been ejected from some peculiar galaxies. Some results are given from an analysis of the two-dimensional distribution of these sources, and their relationship to peculiar galaxies is discussed. Reference was made to Arp's "Atlas of Peculiar Galaxies," and to Vorontsov–Vel'yaminov's "Catalogue of Interacting Galaxies," in these studies. Only presumed extragalactic radio sources from reasonably complete catalogues were chosen for study. An interesting observation was that most of the deviation from randomness appears to be caused by identified sources, rather than unidentified sources. It appears that there is some evidence for a statistical association of certain types of peculiar galaxies and radio sources. Clustering tendencies are also discussed, as well as the distribution of quasi-stellar sources in the revised 3C catalogue. (UK)

26940 ON NON-EINSTEIN GRAVITATION EQUATIONS. Polievktov-Nikoladze, N. M. (Tbilisi State Univ., USSR). Zh. Eksp. Teor. Fiz., 52: 1360-7(May 1967). (In Russian).

A general form of the Lagrangian is found which agrees with the empirical data on weak gravitational fields. The general natur of the corresponding gravitation equations is investigated. It is shown that, formally, the difference between the latter and the Einstein equations is quite arbitrary. In a number of cases, however, they quantitatively coincide with the Einstein equations due to some special boundary conditions the form of which is uniquely determined by the required asymptotic behavior of the field. A final choice between the equations is not possible at present due to incompleteness of the empirical data. (auth)

26941 LUNAR OCCULTATIONS OF TWO RADIO SOURCES. De Jong, Marvin L. (National Radio Astronomy Observatory, Green Bank, W. Va.). Astrophys. J., 148: 651-3(May 1967).

Results obtained from lunar occultations of 3C 132 and 3C 444 on August 21, 1965 and June 9, 1966, respectively, are reported. Both sources were observed at three frequencies (234, 256, and 405 MHz) with the National Radio Astronomy Observatory's 140-foot telescope. (W.D.M.)

26942 THE PECULIAR NEBULA NGC 6302. Minkowski, R.; Johnson, Hugh M. (Univ. of California, Berkeley. Lockheed Missiles and Space Co., Palo Alto, Calif.). Astrophys. J., 148: 659-62(May 1967).

A discussion is given on the properties of the peculiar nebula NGC 6302. The nebula is obviously the result of an explosive event. But the conditions seem to be quite different from those found in planetary nebulae and in remnants of novae and of supernovae. It would thus seem to be an example of a hitherto unrecognized kind of expanding nebulae. (W.D.M.)

26943 STARK BROADENING BY ELECTRON AND ION IMPACTS OF nα HYDROGEN LINES OF LARGE PRINCIPAL QUANTUM NUMBER. Griem, Hans R. (Univ. of Maryland, College Park). Astrophys. J., 148: 547-58(May 1967).

The impact approximation is shown to be a valid description of the Stark broadening of atomic hydrogen $n \rightarrow n + 1$ rf transitions in H II regions. Most of the Stark broadening is through inelastic electron collisions, because broadening by ion and elastic electron collisions is much reduced by a near cancellation of upper- and lower-state perturbations. The ratio of collision and Doppler widths obtained is easily generalized to the corresponding transitions in neutral and ionized helium and to hydrogen nβ lines. Upper limits for electron densities in H II regions obtained from measured profiles and the present calculations are consistent with other observations. (auth)

26944 STABILITY OF THE INTERSTELLAR GAS AND FIELD INCLUDING ROTATION. Lerche, I. (Univ. of Chicago). Astrophys. J., 148: 415-28(May 1967).

The stability of the interstellar gas to perturbations in the gas pressure, magnetic field, and cosmic-ray pressure is discussed from a hydromagnetic point of view taking rotation into account. For a particular model it is shown that the system is unstable to transverse perturbations in the sense described by Parker. This result holds true for a uniformly rotating system bound in a stellar parabolic gravitational well provided only that the Coriolis acceleration is everywhere less than the stellar gravitational acceleration. The tendency for the interstellar gas to drain along the lines of force into the lowest regions of magnetic field is reduced, but not removed, by rotation. The e-folding time is of the order of the free-fall time under an effective gravity $(g - r\Omega^2)$. The results are derived for a particular model, but their physical content should be of general validity for all systems. (auth)

26945 MEASUREMENTS OF THE FLUX DENSITIES, POSITIONS, AND ANGULAR WIDTHS OF PLANETARY NEBULAE AT 10- AND 21-CM WAVELENGTHS. Thompson, A. R. (Stanford Univ., Calif.); Colvin, R. S.; Stanley, G. J. Astrophys. J., 148: 429-42(May 1967).

Observations of thirty-six planetary and two diffuse nebulae were made using the two 90-foot-diameter antennas which comprise the interferometer at Owens Valley Radio Observatory. At a wavelength of 10 cm, flux densities down to a limit of 10^{-27} W $m^{-2}Hz^{-1}$ and right ascensions were measured. At 21 cm flux densities down to 2×10^{-27} W $m^{-2}Hz^{-1}$ and declinations were measured for 22 strong nebulae. The effects of confusion with nonthermal radio sources were examined statistically. In addition, some indication of the nebulae for which confusion is most serious was obtained from a comparison of the radio positions with optical positions measured from the National Geographic Society–Palomar Observatory Sky Survey plates. Errors in the flux-density measurements resulting from confusion should be small at 10 cm but are more serious at 21 cm. Angular widths of 29 of the nebulae were measured at 10 cm using spacings of 2351 and 4701 wavelengths east–west. The radio widths are in agreement with optical widths for approximately 80% of the nebulae, and in the remaining cases it appears probable that the discrepancies are an indication of confusion or of uncertainties in the optical data rather than nonthermal emission. The ratios of the radio and integrated Hβ flux densities of the nebulae show general agreement with the theoretical ratio for thermal emission, and discrepancies result most probably from errors in the estimated Hβ absorption. Some values of Hβ absorption derived from the radio data are given. IC 418, NGC 6572, and NGC 7027 show significant self-absorption at 10 cm, and estimates of the optical thickness were derived from the spectra. The conclusion from the present observations is that the nebulae radiate as thermal sources, and no clear evidence of nonthermal emission is found. (auth)

26946 INFRARED AND RADIO APPEARANCE OF COCOON STARS. Davidson, Kris; Harwit, Martin (Cornell Univ., Ithaca, N. Y.). Astrophys. J., 148: 443-8(May 1967).

It is possible that a typical very young, massive star may approach the main sequence while imbedded in a small, dense, opaque cloud of gas and dust. Such a "cocoon," if sufficiently large and dense (radius $\sim 10^{17}$ cm, mass ~ 1 $M_\odot$), would absorb the star's radiation and re-emit it at a temperature of about 100°K. In addition, an ionized region formed around the star, within the cocoon, would be a thermal radio source. Such an object would be detectable at infrared and radio wavelengths to a distance of several thousand parsecs. (auth)

26947 AGES AND STRUCTURES OF STARS IN THE h AND χ PERSEI ASSOCIATION. Schild, Rudolph (Yerkes Observatory, Williams Bay, Wis.). Astrophys. J., 148: 449-58(May 1967).

New spectral types determined from recent classification spectrograms for 9 stars in the association surrounding h and χ Persei are given, and the H–R diagram of the clusters and association is compared with evolutionary models of Iben and Stothers. Recent proper motion and radial velocity data are briefly drawn upon in a rediscussion of ages and structures of stars in the association. In the picture of the association which has resulted, χ Persei is found to be 350 pc more distant than h Persei and five million years older. Distances found for χ and h Persei are, respectively, 2500 and 2150 pc, and ages determined are 11.5 and 6.4 million years. Surrounding χ Persei appears to be an association of stars 65 pc in diameter (inner group) and of the age and distance of χ Persei. The M supergiants and extreme Be stars appear to be associated with the χ Persei stellar population. Nuclear cluster h Persei appears to be associated with another, younger stellar population which extends over 200 pc and which is indicated to be at about the mean distance of the two clusters (outer group). Nine O stars are believed to define a third, very young stellar population which at least approximately shares the distance and extent of the outer group. (auth)

26948 ROTATIONAL VELOCITIES OF STARS IN IC 4665. Abt, Helmut A.; Chaffee, Frederic H. (Kitt Peak National Observatory, Tucson, Ariz.). Astrophys. J., 148: 459-63(May 1967).

The B4–B7 V stars in the open cluster IC 4665 have an extremely small mean rotational velocity compared with the Pleiades or field stars, while the mean rotational velocities of the B8–A3 V stars are the same as for the Pleiades. It is suggested that tidal interactions in binary systems, which are frequent in IC 4665 but not in the Pleiades, cause the low mean rotational velocities in the former cluster. (auth)

26949 EVIDENCE OF TIDAL EFFECTS IN SOME PULSATING STARS. I. CC ANDROMEDAE AND SIGMA SCORPII. Fitch, W. S. (Univ. of Arizona, Tucson). Astrophys. J., 148: 481-96(May 1967).

Analyses of the light variation of the δ Scuti star CC Andromedae and of the radial velocity variation of the β Canis Majoris star σ Scorpii, a single-line spectroscopic binary, indicate that the long-period modulations exhibited are caused by tidal deformations induced in the hydrogen and/or helium ionization zones of each primary by a faint companion, resulting in surface zonal variations of the amplitude and phase of each primary's normal radial pulsations. The variations in the tide-raising potential calculated at the center of the apparent disk of σ Scorpii correlate very strongly with the observed variations in the phase zero point of the fundamental pulsation. It is suggested that all the β Canis Majoris and δ Scuti stars exhibiting long-period modulation, and probably also the RR Lyrae stars showing a Blazhko effect, do so because of tidal perturbations induced by faint companions. (auth)

26950 AN INVESTIGATION OF SOLAR EMISSION AT FREQUENCIES OF 35, 70, AND 94 Gc WITH A 4.88-METER DIAMETER TELESCOPE. Takahashi, K. (Univ. of Texas, Austin). Astrophys. J., 148: 497-500(May 1967).

Solar radio emission spectroheliograms at frequencies of 35, 70, and 94 Gc, obtained over a 9-month period from observations with a 4.88-m diameter telescope, indicate that the areas of enhanced brightness on the solar disk at these frequencies coincide with centers of activity and that cross correlation of enhanced brightness temperatures with phage areas is maximum 2 days following the millimeter-wave enhancement. The observed mean millimeter wavelength solar radii relative to the optical radius were 1.040, 1.021, and 1.016 at 35, 70, and 94 Gc, respectively. The average fractional temperature differences between the hottest and coldest antenna temperatures of central solar areas were 0.008, 0.034, 0.040 at 35, 70, and 94 Gc, respectively. (auth)

26951 SPECTROGRAPHIC OBSERVATIONS OF THE FLARE OF JULY 20, 1961. Zirin, Harold (Mount Wilson Observatory, Pasadena, Calif. Palomar Observatory, Pasadena, Calif.); Acton, Loren W. Astrophys. J., 148: 501-9(May 1967).

Spectroscopic observations of the late stages of a limb flare which occurred on July 20, 1961, are presented. Because these observations were made with an achromatic coronagraph, accurate line intensity ratios are possible. The He I and He II line ratios indicate a recombination–cascade spectrum. Measurements of continuum densities give values around 10^{10} in the post-flare loop region and 10^{11} or more in the flare. Ca xv line widths correspond to 4.3×10^{6}°K. A magnetic loop structure which guides successive surges is studied. (auth)

26952 NEW DETERMINATIONS OF THE FARADAY ROTATION FOR EXTRAGALACTIC RADIO SOURCES. Berge, G. L.; Seielstad, G. A. (California Inst. of Tech., Pasadena). Astrophys. J., 148: 367-75(May 1967).

Data are presented on the linear polarization properties of 42 radio sources at a wavelength of 18.0 cm. These are combined with data obtained previously at other wavelengths to obtain rotation measures. The dependence of all reliable rotation measures on the galactic coordinates is interpreted in terms of the magnetic field within the local spiral arm. (auth)

26953 ARE YOUNG GALAXIES VISIBLE? II. THE INTERGRATED BACKGROUND. Partridge, R. B.; Peebles, P. J. E. (Princeton Univ., N. J.). Astrophys. J., 148: 377-97(May 1967).

In a previous publication a model was presented for the formation of galaxies and for the properties of the young galaxies. The time variation of the luminosity and spectrum of the model galaxy is used to compute the integrated background radiation due to the highly red shifted starlight from all the galaxies. This background is compared with the contribution from other sources, local and extragalactic. It is concluded that in the wavelength range from 5 to 15 μ it may be possible to pick out the integrated light of the distant galaxies. The intensity is within reach of present detection techniques. (auth)

26954 PECULIAR GALAXIES AND RADIO SOURCES. Arp, Halton (Carnegie Institution of Washington, D. C. California Inst. of Tech., Pasadena). Astrophys. J., 148: 321-65(May 1967).

It is shown that radio sources are not distributed randomly over the sky but are associated with galaxies, often luminous, peculiar galaxies, and nearby groups of galaxies. The most common pattern observed is a radio source some degrees distance from a peculiar galaxy and a second source about the same distance away on the opposite side. These bracketings across central peculiars are shown to be statistically significant. Evidence of luminous intergalactic material lying along the directions to these radio sources, and also elongated along these directions, is presented. Taken together with the disturbed, eruptive appearance of the central peculiars, these observations suggest that material is ejected oppositely from the central galaxies. The ejected material then forms, or is responsible for the formation of, other galaxies, radio galaxies, quasi-stellar radio sources (QSS), and blank field sources of radio emission. The latter three are shown to comprise the class of radio sources here associated with central peculiars. The regions around NGC 5128 and the Virgo Cluster are shown to be very active, with many radio sources and galaxies emanating in spiral distribution from the central brightest galaxy. This spiral distribution is attributed to rotation of the ejection axis of time. Redshifts of some of the central peculiar galaxies have been observed, and their relation to those redshifts which are known for the associated radio sources are discussed. It does not seem possible to avoid the conclusion that most of the QSS redshifts and a component of the radio galaxy redshifts are due to a cause other than velocity translation of the galaxy. It is concluded that there is a continuity of physical properties bridging the galaxies, radio galaxies, and quasi-stellar radio sources. (auth)

26955 ORIGIN OF COSMIC X RAYS. Gould, Robert J. (Univ. of Calif, San Diego). Amer. J. Phys., 35: 376-93(May 1967).

The field of astrophysical research usually called x-ray astronomy is reviewed. Observational methods and detection techniques are described briefly. Available data on the spectrum of the diffuse background x rays and on discrete x-ray sources are summarized. The interpretation of observational results is then considered. Mechanisms for production and absorption of cosmic x rays, the origin of the diffuse background x rays, and models for individual x-ray sources are discussed. (A.G.W.)

26956 INTERACTION BETWEEN THE SOLAR WIND AND THE SUN'S GENERAL MAGNETIC FIELD. Yen, K. T. (General Electric Co., Philadelphia). AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 5: 1009-14(May 1967).

An analytical study of the interaction between the solar wind, assumed to start uniformly from the sun's surface and the sun's general magnetic field, assumed to be a dipole, is presented. Coupled hydrodynamic and hydromagnetic equations are used to obtain solutions with the property of axial symmetry about the dipole axis. The sun's rotation is not considered. A perturbation analysis is carried out to show how the dipole magnetic field is drawn out by the flow, and how the flow is distorted by the magnetic field. A solution for the interplanetary magnetic field is presented and compared with Parker's curl-free solution. This solution shows the radial component of the magnetic field to be proportional to r^{-2} for large values of r, where r is the radial distance from the sun's center measured in terms of the solar radius. The perturbation of the solar wind by the magnetic field is found to be generally small but different in the subsonic and supersonic regions of the velocity field of the solar wind. In the subsonic region, the solar wind velocity in the polar regions is increased and that near the equator is reduced. In the supersonic region, there is a tendency to reverse this perturbation. (auth)

26957 ROTATION AND THE HELIUM LINE STRENGTHS IN B STARS. Hyland, A. R. (Australian National Univ., Canberra). Nature, 214: 899-900(May 27, 1967).

It has been reported that for hot stars there is a significant positive correlation between their helium line strengths and their apparent rotational velocities (Deeming and Walker, Nature 213: 479(1967)). This has important implications in connection with estimations of the primordial helium abundance, since it means that meaningful determinations of stellar helium content cannot be obtained from observations of helium line strengths in stellar spectra. Some recent investigations of the helium line strengths are reported for B stars of the Southern galactic clusters IC 2391 and 2602. The observations suggest that the strength of the He λ 4471 line for main sequence stars of spectral types B 3 and later is almost wholly dependent on the effective temperature of the star and not on its rotational velocity. Consideration is given as to why conclusions drawn from these new observations differ from those of Deeming and Walker. It is suggested that what was found in the earlier investigations was not that stellar rotation affects the helium line strengths in stellar spectra, but that it gives rise to errors in spectral classification. (UK)

26958 OBSERVATION OF SOLAR RADIO BURSTS WITH HIGHER TIME RESOLUTION. Droege, Franz (Univ., Kiel). Z. Astrophys., 66: 200-214(1967). (In German).

Measuring with a time resolution of 5×10^{-3} s at the frequencies 107, 240, 460, and 1420 Mc mainly, time profiles were found. The characteristic half-value times lie, according to the frequencies, in the range of 0.5 to 0.07 s for α profiles, and in the range of 0.07 to 0.005 s for β profiles. Quasi-periodic structures occasionally appear at the frequencies 240 and 460 Mc. During regular events the period of these γ profiles can be constant within ±20%, it differs, however, for different events between 1.0 and 0.2 s. (auth)

26959 RELATION BETWEEN THE APPEARANCE OF TYPE-III RADIO BURSTS AND THE PRESENCE OF CENTERS OF 169-MHz NOISE STORMS AND 3-cm RADIOWAVE CONDENSATIONS. Hoang, Sang (Observatoire de Paris). Ann. Astrophys., 30: 115-18(Jan.-Feb. 1967). (In French).

The relation between the appearance of type-III bursts and the presence of noise storm centers at 169 MHz is defined. A study was made to determine if there is a relation between the appearance of these bursts and the presence on the sun of radioelectric condensations observed at 3 cm. The results showed that the noise storms and the radioelectric condensations are associated with radioelectric transmission of type-III. By combination of these two solar radioelectric phenomena, the observation of type-III bursts in the vicinity of the earth can be predicted almost positively. (J.S.R.)

26960 ON THE GRAVITATIONAL INSTABILITY IN AN EXPANDING UNIVERSE. REFORMULATION OF LIFSHITZ'S THEORY. Nariai, Hidekazu; Tomita, Kenji; Kato, Shoji (Hiroshima Univ. Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 37: 60-74(Jan. 1967).

In view of the significance of the discovery of a cosmic black-body radiation for the problem of galaxy formation in an evolving universe, an attempt is made to reformulate Lifshitz's relativistic theory of the gravitational instability in such a way that the rewritten formalism permits to make a full comparison with Bonnor's approach based on the Newtonian cosmology. The essence of the reformulation lies in deriving a differential equation for the density contrast $\delta\epsilon/\epsilon$ which is a 4-scalar independent of Lifshitz's coordinate conditions. The differential equation is solved, except for such a time interval that nonadiabatic processes are effective. At the later stage, the equation is the same as Bonnor's, but this does not necessarily mean that both approaches are equivalent to each other at the stage. The latter situation is illustrated by considering a mass concentration in a spherical region, which depends not only on the density contrast, but also on the metric perturbation. (auth)

26961 IDENTIFICATION OF THE X-RAY SOURCE IN SCORPIUS. **Gursky, Herbert (American Science and Engineering, Inc., Cambridge, Mass.). Sky Telesc., 32: 252-5(Nov. 1966).**

A short review of x-ray sources is given and a fairly detailed account of the identification of the x-ray source in Scorpius (Sco X-1) is presented. (W.D.M.)

26962 PHYSICS OF THE SOLAR CORONA. SECOND EDITION. Shklovskii, I. S. ADIWES International Series. Reading, Mass., Addison-Wesley Publishing Co., 1966. 483p. $16.75.

Translation of Fizika Solnechnoi Korony by Louis Anderson Fenn.

New results and methods (solar radioastronomy, rocket research, etc.) are reflected in this edition, along with advances in classical fields of solar physics. The topics covered by the chapters are: observations, emission and absorption lines in spectrum, quantitative chemical analysis, ionization problem, ultraviolet radiation and its influence on earth, radio-emission, theory, and interplanetary gas. (D.L.C.)

26963 SOLAR ATMOSPHERE. **Zirin, Harold. A Blaisdell Book in the Pure and Applied Sciences. Waltham, Mass., Blaisdell Publishing Co., 1966. 510p.**

This book, written for both the uninitiated reader and the trained scientist, summarizes the present understanding of the atmosphere of the sun. The first five chapters deal with instruments, plasma behavior in magnetic fields, and spectra. The remaining nine chapters (solar corona, chromosphere, photosphere, prominences, activity, flares) offer much observational material. (D.L.C.)

26964 EARLY TYPE STARS. **Underhill, Anne B. Astrophysics and Space Science Library. Volume 6. Dordrecht, Netherlands, D. Reidel Publishing Co., 1966. 303p.**

This book presents a summary of the observations on early-type stars. The chapters cover: spectral classification, luminosities of O- and B-type stars, photometry in spectral studies, interstellar material and OB stars, distribution of O and B stars, helium spectrum, wavelength studies, spectroscopic binaries, spectrophotometric techniques, interpretation of normal main-sequence early type spectra, apparently unusual abundances, Wolf–Rayet stars, supergiants and P cygni, Be stars, Shell stars, Of stars, Beta Canis Majoris stars, and theory of normal stellar spectra. (D.L.C.)

Atomic and Molecular Physics

Refer also to abstracts 26036, 26936, 27153, 27163, 27331, 27389, 27405, 27440, and 27611.

26965 (ANL–7220, pp 1-10) SOME PROPERTIES OF THE GENERALIZED OSCILLATOR STRENGTH AND THEIR RELATION TO INELASTIC SCATTERING OF CHARGED PARTICLES. II. THE HYDROGEN ATOM. **Inokuti, Mitio (Argonne National Lab., Ill.).**

Diagrams are given of the generalized oscillator strengths plotted against ln $(Ka_0)^2$ and $(Ka_0)^2$ for n = 2, 3, 4, and 5 states for the hydrogen atom. (M.O.W.)

26966 (ANL–7220, pp 13-18) MATHEMATICAL FORMULAS FOR SOME EXPECTATION VALUES IN THE ATOMIC SCATTERING THEORY. **Kim, Yong-Ki (Argonne National Lab., Ill.).**

Mathematical formulas for some expectation values, such as the atomic form factor and the incoherent scattering function, which are important in the atomic scattering theory, are presented. (M.O.W.)

26967 (ANL–7220, pp 19-20) SPECIFIC PRIMARY IONIZATION BY HIGH-ENERGYS ELECTRON. **Rieke, F. F.; Prepejchal, William (Argonne National Lab., Ill.).**

Calculations are given for the specific primary ionization of H_2 and D_2 by electrons of energies covering the range 0.11 to 2.75 MeV. (M.O.W.)

26968 (CERN–67–05) EVALUATION DE LA PERTE D'ENERGIE UNITAIRE ET DU PARCOURS DE PARTICULES CHARGEES TRAVERSANT UN ABSORBANT QUELCONQUE. (Evaluation of Unitary Energy Losses and Ranges of Charged Particles Traversing a Given Absorbent). **Serre, Claude (European Organization for Nuclear Research, Geneva (Switzerland)). Mar. 17, 1967. 86p. (In French). DTIE. CERN.**

A program for general and rapid calculation of the energy losses of a charged particle by ionization is given. The unitary energy loss (stopping power) and the ranges of particles crossing a given element were calculated. From the results for a simple element the unitary energy loss and the ranges can be calculated for chemical compounds and mixtures containing up to 15 elements. The program is an ensemble of subprograms. It can be used for any energy between 10 MeV and 30 GeV. In an appendix the construction of the program, the structure of the blocks, and the utilization of the program are given. Stopping capacity and ranges calculated by the program are tabulated. (J.S.R.)

26969 (IHT–1–19) BOLTZMANN-STOSSINTEGRALE BEI LADUNGSAUSTAUSCH. **(Boltzmann Collision Integrals for Charge Exchange). Staehle, M. (Technische Hochschule, Stuttgart (West Germany). Institut fuer Hochtemperaturforschung). May 1966. 23p. (In German). (CONF-660448–4). Dep. mn.**

From Meeting of the Professional Group on Plasma and Gas Discharge Physics, Kiel, Germany.

In collisions of particles with different electrical charges, there are, in addition to a purely elastic scattering, collisions with charge exchange. For the case of resonance sign reversal, the diffusion cross section was derived. The Boltzmann collision integrals for the pulse and energy transport equation were represented for resonance sign exchange. Both integrals were solved with the assumption of Maxwell distributions. (tr-auth)

26970 (JINR–P4–3256) OB ODNOM MEKHANIZME OBRAZOVANIYA MOLEKULYARNOGO IONA MEZODEITERIYA. **(On a Mechanism of the Formation of a Mesic Deuterium Molecular Ion). Vesman, E. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1967. 18p. (In Russian). Dep.**

It is assumed that the mesic molecular ion $(dd\mu)^+$ has an excited vibrational level $\nu = 1$ with the momentum K = 1. The initial muonic atoms, $d\mu$, are considered to have distribution (3.1). The mechanism of the formation of the $(dd\mu)^+$ by electric dipole transition is discussed. The initial state is the s wave of the continuous spectrum. The final state is the $(dd\mu)^+$ at the level K = 1, $\nu = 1$. The binding energy of this level, E_d, is considered to excite the vibrational levels of the big molecule consisting of the ion $(dd\mu)^+$, a nucleus d, and electrons. The rate of the formation, w, is found to be dependent on the average kinetic energy, $\overline{E}$, of the initial atom $d\mu$ with the maximum at the point $\overline{E} = E$. The process of the $(dd\mu)^+$ formation is considered to be rapid compared with the period of the nuclear vibrations in a big molecule. Separate approaches are needed for the cases when the atom $d\mu$ collides with the molecule D_2 and when it collides with HD. The dependence of the rate, w, on average kinetic energy of the initial atoms, $d\mu$, is compared with experimental values. The best fit to the experiments at large concentrations of deuterium is found when the point of the maximum lies at $\overline{E} = 0.016$ eV. This assumption and the experimental values suggest the binding energy of $(dd\mu)^+$ in the discussed state $|E_d| \approx (1.5-2)$ eV. The points at $\overline{E} = 0.17$ eV and at $\overline{E} = 0.012$ eV belong to experiments made at small concentrations of the deuterium. In this case the curve should have the maximum rather at the point $\overline{E} = 0.25$ eV than at $\overline{E} = 0.016$ eV. (auth)

26971 (ORNL-TM–1776) OPTICAL PROPERTIES OF SODIUM IN THE VACUUM ULTRAVIOLET. **Sutherland, J. C.; Hamm, R. N.; Stevenson, J. R.; Arakawa, E. T. (Oak Ridge National Lab., Tenn.). May 1967. Contract W-7405-eng-26. 126p. Dep. CFSTI.**

Thesis. Submitted by J. C. Sutherland to Georgia Inst. of Tech., Atlanta.

An experiment was carried out to extend the measurements of the optical constants of sodium into the vacuum-ultraviolet region of the spectrum, and to compare the optical constants measured in this region with those measured in the near-ultraviolet, visible, and infrared regions, with the results of electron-energy-loss experiments, and with current theories of the optical properties of metals. (M.O.W.)

26972 (ORNL-TM–1777) MEAN EXCITATION ENERGIES CALCULATED FROM STOPPING-POWER AND RANGE DATA. **Dalton, Patricia; Turner, J. E. (Oak Ridge National Lab., Tenn.). June 1967. Contract W-7405-eng-26. 55p. Dep. CFSTI.**

Thesis. Submitted to Vanderbilt Univ., Nashville, Tenn.

Mean excitation energies (I values) have been calculated from the data of nine key experiments that measured absolute stopping power, relative stopping power, or range. The experiments reviewed are those of Bakker and Segrè (1951); Thompson (1952); Sachs and Richardson (1953); Brolley and Ribe (1955); Burkig and MacKenzie (1957); Zrelov and Stoletov (1959); Nielsen (1961); Barkas and von Friesen (1961); and Nakano, MacKenzie, and Bichsel (1963). New shell corrections (C/Z) for the entire atom are included. I values obtained from relative stopping-power measurements have been normalized to I = 163 eV for aluminum and I = 314 eV for copper. The results of the analysis indicate that: (1) the absolute stopping-power data of Sachs and Richardson does not fit the general trend described by the other data; (2) a standard reference on stopping power, National Bureau of Standards

Handbook 79, Stopping Powers for Use with Cavity Chambers (1961), which does not include the more recent data, does not include adequate shell corrections; (3) agreement is good with a recent report of the National Academy of Sciences–National Research Council, Studies in the Penetration of Charged Particles in Matter (1964), which includes suggested I values based on empirical estimates of the shell corrections; and (4) a good estimate of I (eV) can be found from the equations $I = (10.2 \pm 2.07) + (11.8 \pm 0.55)Z$, for $Z \leq 13$, and $I = (56.1 \pm 8.76) + (8.61 \pm 0.37)Z$, for $Z > 13$. (auth)

26973 (PUC–937-257) ATOMIC BEAMS AT PRINCETON: HIGHLIGHTS. Hamilton, Donald R.; Phillips, E. Alan; Ames, Oakes (Princeton Univ., N. J. Palmer Physical Lab.). Apr. 1967. Contract AT(30-1)-937. 21p. Dep. CFSTI.

A research program on the spins and electromagnetic moments of radioactive nuclei is being conducted using atomic beams. The atomic-beam techniques and apparatus developed are described. The theory of odd–odd nuclei and the magnetic moments of mirror nuclei are discussed. A comparison is made between calculated and experimental magnetic moments for $1f_{7/2}$ nuclei. (D.L.C.)

26974 (TID–23760, pp 1-11) MOLECULAR BEAMS. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics).

Theoretical and experimental results are presented on square-wave phase modulation in molecular beam resonance experiments. Further developments on the search for a shift in the transverse electromagnetic mass of the electron are presented. (M.O.W.)

26975 (USC–136-120) L-SHELL CORRECTION IN STOPPING POWER. Bichsel, Hans (University of Southern California, Los Angeles. Nuclear Physics Lab.). Apr. 1967. Contract AT(04-3)-136. 21p. Dep. CFSTI.

A short description of the stopping power formula including the shell corrections is given. Extensive tables for the stopping number, B_L, and the L-shell correction, C_L, have been computed and are given. B_L and C_L are given for $0.35 \leq \theta_L \leq 0.65$ in steps of 0.05, for $0.01 \leq \eta_L \leq 0.15$ in steps of 0.01, and for $0.15 \leq \eta_L \leq 5.0$ in steps of 0.05. (auth)

26976 RESONANCE CHARGE EXCHANGE BETWEEN LOW-ENERGY PROTONS AND DEUTERONS. Belyaev, V. A.; Brezhnev, B. G.; Erastov, E. M. Zh. Eksp. Teor. Fiz., 52: 1170-7 (May 1967). (In Russian).

The cross sections for resonance charge exchange of protons on hydrogen atoms and of deuterons on deuterium atoms are measured in the 5 to 100 eV energy range by the overtaking beam technique. The results are compared with previously published experimental and theoretical data. (auth)

26977 AN EXPERIMENT OF THE OVERHAUSER EFFECT. Shimoji, Sadao (Mitsubishi Electric Corp., Amagasaki, Japan). Mitsubishi Denki Giho, 6: 1-24(Jan. 1965).

Information concerning the relaxation mechanism of electron spin and of nuclear spin, and the nature of their coupling was obtained from examination of the Overhauser effect using an aqueous solution of $NO(SO_3)_2^=$ and of Mn^{++} ions. The spin-lattice relaxation of electron spin resonance (ESR) was determined in low magnetic fields. Some experimental results are described and an introductory explanation of the Overhauser effect in solution is given. For a quantitative estimate, the ESR saturating field H_{1e} in the ESR coil and the influence of the concentration of the sample on H_{1e} were examined with an induced voltage in a 1-turn pick-up coil. The presence of sample in the ESR coil weakened H_{1e}. As the concentration increased, H_{1e} decreased, but the power absorbed by sample increased with a small probe when the pick-up coil method could not be used, the voltage across the ESR coil was an accurate indicator of H_{1e}, but calibration of the capacitor dividing ratio was needed. The longitudinal relaxation time of the ESR was obtained from the H_{1e} dependence of the enhancement of proton polarization and the transverse relaxation time was obtained from the field H_0 dependence of the enhancement for the constant ESR frequency. Positive and negative enhancement of proton polarization was observed with aqueous solutions of Mn^{++} ion. The sign of the enhancement changed with temperature and magnetic fields, owing to the variation of the relative magnitude of the dipolar and the scalar coupling between the proton spin and the electronic spin. At the temperatures above 40°C, recovery of the effect of scalar coupling was observed. For the relaxation time of Mn^{++} ion the scalar coupling constant was estimated to be about 2.4×10^{-5} cps. (BBB)

26978 SU(4)-SYMMETRY AND THE HYDROGEN ATOM. Mozrzymas, J. (Univ. of Wroclaw). Acta Phys. Pol., 31: 469-77(Mar. 1967).

It is shown that in Rzewuski's model as the result of the connection of SU(2) and $SU(2)_I$ two particles appear having the following properties: they interact with Coulomb potentials with opposite signs; the energy spectra are continuous; in every fixed coordinate system in isotopic space the coordinates of both particles behave under space rotations $O_3(SU(2))$ like coordinates of a free particle; the transformations of isotopic spin mix the coordinates of both particles. (auth)

26979 PRESSURE-DEPENDENT CHARACTERISTICS OF AN OAK RIDGE-TYPE DUOPLASMATRON ION SOURCE. I. DISCHARGE CHARACTERISTICS. Watanabe, Masanori (Matsushita Electric Industrial Co., Ltd., Osaka); Suita, Tokuo. Jap. J. Appl. Phys., 6: 758-64(June 1967).

The pressure dependence of discharge characteristics of an Oak Ridge-type duoplasmatron ion source was studied with a Langmuir probe. It was found that the pressure dependent characteristics relate to the radial component of the magnetic field near the tip of the intermediate electrode. A fire ball of dense plasma is built up at the neck of the intermediate electrode and there arises a potential difference between the fire ball and anode. It was observed that the potential difference varied from 17 to 50 V with variation in hydrogen gas pressure. The mean energy of electrons emerging from the anode aperture was measured by an ac thermocouple. It amounts to 51 eV at a gas pressure of 0.06 torr. The mean energy of electrons corresponds to the potential difference between the fire ball and anode. (auth)

26980 LONGITUDINAL SPACE-CHARGE WAVES. Trotman, R. E. Modern Electrical Studies Series. New York, Barnes and Noble, Inc., 1966. 227p. $5.50.

A brief review of the early history of the subject and information on some fundamental properties of waves and electron beams are given. The theory of propagation of longitudinal space-charge wave on both mono-velocity and multi-velocity electron beams moving in magnetic focusing fields is discussed in detail. Theoretical mechanisms for producing increasing space-charge waves on single electron beams are considered, and some experimental amplifiers are described and discussed. The interactions between two electron beams are examined in considerable detail, and some practical devices that utilize the increasing space-charge wave obtained in such such reactions are described and discussed. The power flow associated with space-charge waves is also considered. (W.D.M.)

26981 CONCENTRATION OF EXCITED ATOMS IN A PULSED DISCHARGE IN MERCURY VAPOR. Egorov, V. S.; Skrebov, V. N.; Shukhtin, A. M. Opt. Spectros. (USSR) (Engl. Transl), 22: 4-6 (Jan. 1967).

Translated from Opt. Spektros., 22: 9-13(Jan. 1967).

The populations of the first excited 6s6p $^3P_{0,1,2}$ levels of mercury atoms were measured by the hook method at various phases of a short current pulse. Initial metal vapor pressures were 0.01 to 1 mm. The current density in the discharge varied from 10 to 100 A/cm². The duration of the discharge did not exceed 10 μsec The relationship between the length of the current pulse and the flash from the continuous spectrum source is shown. The change of concentration of excited mercury atoms with time and the variation of the intensity of various mercury lines with time are also shown. (M.H.R.)

26982 INDUCED AND SPONTANEOUS EMISSION IN CROSSED FIELDS. Sokolov, A. A.; Pavlenko, Yu. G. Opt. Spectros. (USSR) (Engl. Transl.), 22: 1-3(Jan. 1967).

Translated from Opt. Spektros., 22: 3-8(Jan. 1967).

The induced emission and absorption of an electron moving in crossed electric and magnetic fields is investigated by quantum mechanical methods. The case when emission should prevail over absorption is considered. (auth)

26983 LOWEST-ORDER CORRECTION TO MANY-FERMION VERTEX FUNCTION. Layzer, Arthur (Stevens Inst. of Tech., Hoboken, N. J.). J. Math. Phys. (N. Y.), 8: 532-5(Mar. 1967).

The lowest-order vertex correction, the exchange counterpart of the polarization correction, is evaluated for all values of the energy and momentum transfer variables and for an arbitrary rotationally invariant two-body interaction. The method employs a dispersion theory technique and an angular expansion of the interaction in spherical harmonics. For any partial wave, the result is expressed as a one-dimensional integral over a closed interval that can easily be evaluated numerically once the form of the interaction is specified. Explicit expressions can be obtained for the long wavelength limit, and for an expansion in powers of the momentum transfer variable. In this case the result depends on the value of the interaction and its momentum derivatives when one of the momentum variables lies on the Fermi surface. (auth)

26984 SYMMETRY GROUP OF THE HYDROGEN ATOM. Finkelstein, R. J. (Univ. of California, Los Angeles). J. Math. Phys. (N. Y.), 8: 443-9(Mar. 1967).

It is shown how the complete dynamics of the hydrogen atom is related to the three-dimensional rotation group. (auth)

26985 EFFECT OF DENSITY AND AGGREGATE STATE OF TARGET ON THE CHARGE COMPOSITION OF LITHIUM, SODIUM, AND POTASSIUM IONS. Pivovar, L. I.; Nikolaichuk, L. I.; Trubchaninov, F. M. (Physical-Technical Inst., Kiev). Zh. Eksp. Teor. Fiz., 52: 1160-9(May 1967). (In Russian).

The charge compositions of lithium, sodium and potassium ion beams after traversal through magnesium or cadmium vapor or condensed magnesium, cadmium, silver and celluloid targets are measured. The vapor measurements are performed at pressures between 10^{-5} and 7×10^{-1} mm Hg. In this way the cross section for electron capture by Li^+, Na^+ and K^+ ions could be estimated and the contribution of excited atoms to the mean ion charge could be determined. The results obtained confirm the applicability of the Bohr–Lindhard theory to ions which are lighter than uranium fission fragments. Comparison of the ion charge distributions in vapors and films indicates an appreciable difference in the dependence of the electron capture and loss cross sections on the aggregate state of a given substance. The measurements were performed at energies ranging from 20 to 150 keV. (auth)

26986 RADIATION OF RELATIVISTIC ELECTRONS IN LAMELLAR MEDIA. Arutyunyan, F. P.; Ispiryan, K. A.; Oganesyan, A. G.; Frangyan, A. A. (Erevan State Univ.). Zh. Eksp. Teor. Fiz., 52: 1121-33(May 1967). (In Russian).

Experimental results are presented of an investigation of the properties of x-ray radiation produced by 600-MeV electrons in lamellar media. The radiation spectrum and dependence of the radiation intensity on electron energy, period of the lamellar medium, and number of layers are investigated. Emission of 60 to 70 keV γ quanta in the lamellar medium is observed, the intensity of the radiation exceeding that of the corresponding bremsstrahlung radiation by many times. The experimental results are compared with the theory of resonance emission. The absolute values of the results are greater than the theoretical values, in some cases even by an order of magnitude; this seems to indicate that the discrepancy may be due to significant electron scattering. (auth)

26987 THE KAPITZA–DIRAC EFFECT IN A STRONG RADIATION FIELD. Fedorov, M. V. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz., 52: 1434-45(May 1967). (In Russian).

Scattering of electrons under the action of a strong standing electromagnetic wave is considered. It is shown that scattering occurs in the directions defined by the Laue conditions. Equations are derived for the electron scattering probability amplitudes. Formulas for determining saturation of the scattering probability in the case of prolonged interaction between the electrons and field are also deduced. Asymptotic expressions are obtained under some assumptions for the scattering amplitudes in a strong radiation field. Numerical estimates are presented and comparison with the experiments is carried out. (auth)

26988 THE SCATTERING OF LOW-ENERGY ELECTRONS ON METHANE. THE SECOND IONIZATION POTENTIAL. Ehrhardt, H.; Linder, F. (Univ., Freiburg i. B.). Z. Naturforsch., 22a: 11-14(Jan. 1967). (In German).

Measurements are made of the inelastic scattering of electrons from methane into large scattering angles. The results show the appearance of a collision process at 19.5 ± 0.2 eV. From the measured angular dependence of the differential scattering cross section, this collision process is identified as an optically forbidden transition. The classification of this transition ($2\ sa_1 \rightarrow 3\ sa_1$) and a value of the second appearance potential of methane (between 23.5 and 24 eV) are deduced from analogous transitions in neon. (auth)

26989 ELECTRON BEAM RADIATION TESTS: MAXIMUM DOSE RATE VS SAMPLE SIZE. Martin, James A. (IBM Corp., Owego, N. Y.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci., NS-14: No. 2, 22-4(Apr. 1967).

Restrictions on sample size when irradiating with electron beams are discussed. It is shown that peak dose rate, D, beam current, I_B, and a sample length, l (perpendicular to beam axis), are related by $l^2D/I_B = 1.91 \times 10^{11} \ln (1/\beta)$, where β is the ratio of the dose rate at the edge of the sample is centered on the beam. Centimeters, rad/sec, and ampere are the units appropriate to the above parameters. (auth)

26990 BORN CROSS SECTIONS FOR SINGLE-TRANSITION COLLISIONS OF TWO HYDROGEN ATOMS. Pomilla, Frank R. (Grumman Aircraft Engineering Corp., Bethpage, N. Y.). Astrophys. J., 148: 559-71(May 1967).

Inelastic collisions of two hydrogen atoms were studied in which only one of the atoms makes the jump to a higher quantum level and the other remains in the ground state. Born cross sections were calculated for the reactions $H(1s) + H(nl) \rightarrow H(1s) + H(n'l')$, where $n \leq 7$, $\Delta n \geq 1$, and Δl takes on all possible values. The results are tabulated for the total-level cross sections for ($n \rightarrow n'$) transitions, calculated from the cross sections for the ($nl \rightarrow n'l'$) transitions by taking the appropriate averages over l and summations over l′. The results indicate that for incident energies less than 10 keV, the Born cross sections for all the single-transition collisions studied are larger than those for corresponding double-transition collisions. (auth)

26991 INTERCOMBINATION LINE OSCILLATOR STRENGTHS IN THE HELIUM ISOELECTRONIC SEQUENCE. Elton, R. C. (Naval Research Lab., Washington, D. C.). Astrophys. J., 148: 573-8(May 1967).

The ratios of oscillator strengths for transitions into the $1s^2\ {}^1S_0$ ground state from the $1s2p\ {}^1P_1$ and $1s2p\ {}^3P_1$ states, respectively, were calculated for helium and helium-like ions through Ne IX using an energy matrix which includes spin–orbit and spin–spin interactions. The desired ratio is expressed principally in terms of term values deduced from some observed $2^3S_1 - 2^3P_{0,1,2}$ transitions. Such observations for O VII are reported. Oscillator strengths for the $1^1S_0 - 2^3P_1$ intercombination transition are deduced using calculated values for the $1^1S_0 - 2^1P_1$ transition. The results are useful in interpreting soft x-ray line radiation from such transitions as observed in the solar corona as well as in high-temperature laboratory-generated plasma. (auth)

26992 INTERCOMBINATION-LINE OSCILLATOR STRENGTHS IN THE HELIUM AND BERYLLIUM ISOELECTRONIC SEQUENCES. Garstang, R. H.; Shamey, Louis J. (Joint Inst. for Laboratory Astrophysics, Boulder, Colo.). Astrophys. J., 148: 665-6(May 1967).

The values of gf for the $2^1S_0 - 2^1P_1$ transitions are given, together with the final oscillator strengths, transition probabilities, and predicted wavelengths for the $2^1S_0 - 2^3P_1$ transitions. The gf-value for the BeI line leads to a ratio of intensities $I(2^1S_0 - 2^3P_1)/I(2^1S_0 - 2^1P_1) = 5.0 \times 10^{-7}$ for a source in thermal equilibrium at 5000°K. (W.D.M.)

26993 NEWLY IDENTIFIED RESONANCE LINES OF Ni XIX, Cu XX, AND Zn XXI. Feldman, U.; Cohen, L.; Swartz, M. (Goddard Space Flight Center, Greenbelt, Md.). Astrophys. J., 148: 585-7(May 1967).

By using a grazing-incidence spectrometer and a low-inductance condensed-spark source, the spectra of Ni XIX, Cu XX, and Zn XXI were observed. By extrapolating the known data of the Ne I isoelectronic sequence, the new lines were identified as belonging to transition arrays between the ground level $2s^22p^6\ {}^1S_0$ and the following electronic configurations: $2s^22p^53s$, $2s^22p^53d$, and $2s2p^63p$. Some of these lines may be emitted from the solar corona. (auth)

26994 MAGNETIC QUADRUPOLE LINE INTENSITIES. Garstang, R. H. (Univ. of Colorado, Boulder). Astrophys. J., 148: 579-84(May 1967).

A tensor operator formalism is given for the calculation of magnetic quadrupole transition probabilities. The method is applied to the $s^2\ {}^1S_0 - sp\ {}^3P_2$ transition in the general case and then to eight individual cases (He I, O VII, Be I, Si XI, Mg I, Zn I, Cd I, and Hg I). It is shown that, in the first six of these, magnetic quadrupole radiation is more important than nuclear-spin-induced electric dipole radiation, the converse being true for Cd I and Hg I. Magnetic quadrupole radiation in the transition ${}^1S_0 - {}^3P_2$ appears to have been observed in the laboratory for Zn I, probably contributes to the laboratory Cd I line, and is largely responsible for the Mg I line in NGC 7027. (auth)

26995 COLLECTIVE EFFECTS IN THE PHOTOABSORPTION CROSS SECTIONS OF ATOMS AND MOLECULES. Brandt, Werner (New York Univ., N. Y.); Lundqvist, Stig. J. Quant. Spectros. Radiative Transfer., 7: 411-21(May-June 1967).

The linear response of atoms and molecules to an external field is formulated in a self-consistent manner. The discussion centers on the collective effects in the spectral properties at frequencies higher than the first ionization edge, and their experimental manifestations. Photoabsorption and the photoelectric effect are shown to have distinct cross sections which happen to coincide only in certain approximations, such as in the single-particle model. The line profile of autoionization levels is derived and compared with recent experimental observations. (auth)

26996 CONTRIBUTION OF INVERSE NEUTRAL BREMSSTRAHLUNG TO THE ABSORPTION COEFFICIENT OF HEATED AIR. Mjolsness, R. C.; Ruppel, H. M. (Los Alamos Scientific Lab., N. Mex.). J. Quant. Spectros. Radiative Transfer, 7: 423-7(May-June 1967). (LA-DC-8331).

The contributions to the spectral absorption coefficient of inverse bremsstrahlung from electrons in the fields of neutral oxygen and nitrogen atoms and nitrogen molecules are tabulated for air temperatures of 4000 to 12,000°K and for photon energies of 0.6 to 3.0 eV. The atomic and total contributions are tabulated separately. The molecular contributions may well be evaluated significantly more accurately in the future. For brevity, values are given at only four air densities. (auth)

26997 STUDY OF LOW-ENERGY ELECTRON GUNS. **Mosser, A.; Burggraf, Ch. (Faculte des Sciences, Strasbourg). Rev. Phys. Appl., Suppl. J. Phys., 2: 57-61(Mar. 1967). (In French).**

An apparatus allowing one to determine current density and velocity distributions in electrons beams having energy in the range of 100 to 500 eV has been designed and tested. This apparatus was used to study different types of electron guns. (auth)

26998 DEPENDENCE OF 50- AND 100-keV BREMSSTRAHLUNG ON TARGET THICKNESS, ATOMIC NUMBER, AND GEOMETRIC FACTORS. **Placious, R. C. (National Bureau of Standards, Washington, D. C.). J. Appl. Phys., 38: 2030-8 (Apr. 1967).**

Experimental data have been obtained for the bremsstrahlung spectra produced with 50- and 100-keV electrons incident on different targets. The spectrum per unit solid angle per incident electron is measured for photon emission angles of 30, 70, and 110 deg, for normal and oblique incidence of the electrons on the targets having atomic numbers of 13, 50, and 79, and for four target thicknesses equal to different fractions of the electron range in the given material. Also, results are given for the bremsstrahlung production efficiencies per unit solid angle at a given emission angle. The experimental results at normal incidence show good agreement with the theoretical predictions of Berger and Seltzer, which are based on thin-target bremsstrahlung cross sections and which employ Monte Carlo calculations to account for multiple scattering and energy-loss effects. Similar calculations for other geometries should produce reliable estimates of the emitted bremsstrahlung spectra in this same energy region. (auth)

26999 SECONDARY EMISSION STUDIES ON Ge AND Na-COVERED Ge. **Palmberg, P. W. (Univ. of Minnesota, Minneapolis). J. Appl. Phys., 38: 2137-47(Apr. 1967).**

The influence of work-function reduction and variation of the incident-beam angle on the secondary-electron yield and secondary-electron energy distribution from the (111) face of Ge have been studied. Reduction of the work function from 4.79 to 2.3 eV by deposition of Na increased the maximum yield from 1.2 to a value near 3.6, while the primary energy at which the maximum yield occurred increased from 700 to 2000 eV. The energy width of the slow secondary-electron energy distribution function decreased strongly both with increasing primary energy and decreasing work function. An investigation of the energy of secondary electrons involved in the yield variation with incident beam angle suggests that this variation in yield is a direct result of variation in the primary-electron backscattering coefficient. A bulk plasma loss of 16.7 eV is manifested in the total secondary-electron energy distribution function by a series of peaks lying at multiples of 16.7 eV below the elastic peak. In addition, a shoulder on the first 16.7 eV loss peak indicates the existence of an 11-eV surface plasma loss. An overlayer of Na does not seriously affect the bulk plasma loss spectrum, but shifts the 11-eV surface loss to about 13 eV and causes the appearance of a second 3.5-eV surface loss peak. (auth)

27000 MULTIPLE IONIZATION PROCESSES IN HELIUM. **Byron, F. W. Jr. (Univ. of Massachusetts, Amherst); Joachain, C. J. Phys. Lett., 24A: 616-17(May 22, 1967).**

The phenomenon of double ionization in helium by photon impact is considered. Comparison is made with recent experiments by Carlson, and it is shown that the inclusion of atomic correlation is crucial. Conclusions are drawn concerning the related electron impact problem. (auth)

27001 APPLICATION OF THREE-PARTICLE THEORY TO THE SCATTERING OF ELECTRONS BY A HYDROGEN ATOM. **Veselova, A. M. (Leningrad State Univ.). Phys. Lett., 24A: 594-6(May 22, 1967).**

The exact three-particle theory is applied to the electron + hydrogen atom scattering problem. A very rough approximation is worked out for the case of low energy S-wave scattering. The results obtained are in qualitative agreement with the known facts. (auth)

27002 MEASUREMENT OF THE ANGULAR DISTRIBUTION OF ELECTRONS BY THE ELEMENTARY PROCESSES OF BREMSSTRAHLUNG PRODUCTION. **Hub, R.; Nakel, W. (Univ., Tuebingen, Ger.). Phys. Lett., 24A: 601-2(May 22, 1967). (In German).**

By using a coincidence method, the angular distribution of electrons is measured for a definite energy loss and a definite angle of the outgoing quantum of bremsstrahlung, at an incident electron energy of 300 keV. (auth)

27003 POLARIZATION OF LIGHT EMITTED BY AN ATOMIC BEAM OF BARIUM UNDER ELECTRON BOMBARDMENT. **Kelly, F. M.; Tomchuk, E. (Univ. of Manitoba, Winnipeg, Can.). Phys. Lett., 24A: 602(May 22, 1967).**

The singlet resonance radiation from an atomic beam of barium, excited by electron bombardment, has been examined for polarization. Theory predicts an observable effect, but none was found. (auth)

27004 EXCITATION OF INERT GASES DURING ELECTRON–ATOM COLLISIONS. III. ARGON. **Feltsan, P. V.; Zapesochnyi, I. P. (Uzhgorod State Univ., USSR). Ukr. Fiz. Zh., 12: 633-40(Apr. 1967). (In Russian).**

The results are presented of thorough investigations of effective cross sections of the excitation of argon lines corresponding to the transitions $3p^5\,4s-3p^54p$, $3p^54p-nd$, $3p^5$, $4p-3p^5\,n's(n' \geq 5)$ within the interval from the excitation threshold to 150 eV. Measurements were taken at pressures $p = (0.7 \text{ to } 3) \times 10^{-3}$ mm Hg and electron current density $j = (0.1 \text{ to } 3) \times 10^{-3}$ a/cm^2. The inhomogeneity of the electrons under working conditions did not exceed 1.2 eV. The results of the measurements are represented in the form of absolute excitation functions. The effective cross sections of argon level excitation of configuration $3p^54p$ are determined by the data of the line excitation measurements. For the lower three levels ($2p_8$, $2p_9$, $2p_{10}$) the value of the cascade transitions was found to be 25–55%. (auth)

27005 STUDY OF THE ELECTROSTATIC CAPTURE OF RADIUM A. **Dubois, Emmanuel; Roche, Jean; Andanson, Pierre (Faculte des Sciences, Clermont-Ferrand, France). Cah. Phys., 20: 369-76(Oct. 1966). (In French).**

Positively charged RaA atoms are captured by a metal disk belonging to the plate of a plane capacitor placed in air containing radon. This capture is studied by counting β particles produced by RaE issued from RaA. The existence of a saturation capture is shown. Some RaA atoms are negatively charged under the action of the gas ionization. The emission of the active disk increases with the atomic number of the matter of the disk. This phenomenon is caused by the backscattering of β particles emitted by RaE. (auth)

27006 TRANSMISSION AND RANGE OF FAST ELECTRONS IN THE ENERGY REGION 4 TO 30 MeV. **Harder, D.; Poschet, G. (Univ., Wuerzburg, Ger.). Phys. Lett., 24B: 519-21(May 15, 1967). (In German).**

Transmission coefficients and ranges of fast electrons in C, Al, Cu, Cd, and Pb were measured using a large area proportional counter. As predicted by diffusion theory for $E_0 \gg m_ec^2$, the parameter Zm_ec^2/E_0 governs the shape of the normalized transmission curve and the range to pathlength ratio. (auth)

27007 PRECISION REDETERMINATION OF THE HYPERFINE STRUCTURE INTERVAL OF POSITRONIUM. **Theriot, E. D. Jr.; Beers, R. H.; Hughes, V. W. (Yale Univ., New Haven). Phys. Rev. Lett., 18: 767-9(May 8, 1967).**

The method used for the determination of the hfs interval involves the observation of a Zeeman transition between $M = \pm 1$ and $M = 0$ magnetic substates of orthopositronium. This experiment studies the change in the number of coincidence 0.511-MeV annihilation gamma rays emitted 180° apart, whereas earlier experiments studied the change in shape of the annihilation–gamma-ray spectrum accompanying a transition. Adequate agreement is obtained between experiment and theory. By studying the linewidth of the Zeeman transition as a function of microwave magnetic field intensity, the natural linewidth is determined, from which the annihilation rate of the singlet state is calculated. This result is also in good agreement with theoretical values. (L.B.S.)

27008 SCATTERING OF SLOW NEUTRONS BY ETHYLENE ADSORBED ON ACTIVATED CHARCOAL. **Todireanu, S. (Inst. for Atomic Physics, Bucharest). Phys. Lett., 24A: 544-5 (May 8, 1967).**

Some preliminary results obtained in the study of molecular dynamics of ethylene adsorbed on activated charcoal, by slow neutron scattering, are presented. (auth)

27009 COMPLEX ANGULAR MOMENTUM AND UNSTABLE LEVELS OF H-LIKE ATOMS AND POSITONIUM. **Sannikov, S. S. (Ukrainian Physical-Technical Inst., Kharkov). Nucl. Phys., B1: 577-80(1967).**

The physical consequences of the introduction of complex angular momentum to unstable states of H-like atoms and positonium are considered. (auth)

27010 OPTICAL ORIENTATION OF ATOMS AND OF NUCLEI: APPLICATIONS. **Bene, Georges-J.; Geneux, Edmond (Univ., Geneva). Ind. At., 11: Nos. 3-4, 41-52(1967). (In French).**

The rules for making selections involving the exchange of kinetic movement between atoms and radiation (light) are given in terms of the state of polarization of that radiation. Attention is then directed to how an optical resonance beam suitably polarized enables a single Zeeman sublevel to be filled with a condition of atomic excitation; the notion of optical pumping, which allows for the polarization of atoms at the basic level, is described. It is shown that a phenomenon of magnetic resonance is observed as a variation in rates of polarization of the diffused light (variation of momentum). Then, certain properties are stated of systems having a transverse magnetization (perpendicular to a controlling magnetic field), in particular the dependence of the amplitude of a resonance produced by a magnetic field oscillating parallel to the controlling field. (auth)

27011 DEUTERON AND ^{35}Cl SPIN LATTICE RELAXATION IN DCl AND HCl. Powles, J. G.; Rhodes, M. (Univ. of Kent, Canterbury, Eng.). Phys. Lett., 24A: 523-4(May 8, 1967).

Molecular reorientation in liquid and upper-solid-phase DCl was found to be rapid, unaffected by melting, and probably diffusional. (auth)

27012 ANALOGUE AND PRACTICAL STUDIES OF A LOW-VOLTAGE ELECTRON GUN. Gregory, B. C.; Beck, A. H. W. (Cambridge Univ., Eng.). Int. J. Electron., 21: 561-75(Dec. 1966).

An investigation of the performance of a medium-perveance, high-convergence electron gun, when operated at low voltages so that thermal velocities were important in determining the beam conditions, is described. The gun was designed following the work of Danielson et al. (1956), together with the use of an automatic trajectory tracer, with facilities for injection of space-charge information. The trajectory tracer predicts a fairly uniform cathode loading with some spherical aberration in the beam. The gun was studied in a demountable system using a pin-hole analyzer. The results confirm the predictions of the trajectory tracer and show that the results of Danielson et al. predict the beam diameter with reasonable accuracy. Some initial experiments on fitting a confining magnetic field to the gun region and the resultant beam profiles are described. (auth)

27013 CORRELATION BETWEEN DECAY LIFETIME AND ANGULAR DISTRIBUTION OF POSITRON ANNIHILATION IN THE PLASTIC SCINTILLATOR NATON. Hsu, F. H. H.; Wu, C. S. (Columbia Univ., New York). Phys. Rev. Lett., 18: 889-91(May 22, 1967).

An experiment is described which succeeded in resolving the connection between lifetimes for positron annihilation in the plastic scintillator Naton. This was done by measuring the lifetime spectra at different angles between the annihilation gamma rays, using a better time resolution. Lifetime spectra, an angular correlation curve, and annihilation photopeaks are shown. (J.F.P.)

27014 RELATIVE STOPPING POWER OF A SUBSTANCE FOR α-PARTICLES AT 5 MeV. Fiedler, O.; Ulrich, D. (Institut fuer Experimentelle Kernphysik, Dresden). Z. Phys., 200: 493-8(1967). (In German).

The stopping power of Al, Ag, Au, zapon, and paraffin for α particles from 0.5 to 5 MeV was experimentally determined with respect to air and H_2. In the range of validity of the Bethe–Bloch theory, the measured values agree well with the calculated values. According to the Bragg rule the relative stopping power for α particles of 5 MeV was calculated for the organic substances zapon, paraffin, mylar, and formvar. The measurement values obtained for zapon and paraffin agree approximately. The values for zapon and formvar deviate from the values of De Croes. (tr-auth)

27015 INVESTIGATION OF A THERMAL SOURCE OF GROUND STATE HYDROGEN ATOMS. Valyi, Laszlo. KFKI (Kozp. Fiz. Kut. Int.) Kozlem., 15: 95-103(1967). (In Hungarian).

The atomic hydrogen beam produced by thermal dissociated in a tungsten oven was investigated in terms of different source parameters. The temperature dependence of the dissociation rate measured at varied gas pressures was found to be in good agreement with the calculated dissociation vs temperature characteristics. (auth)

27016 ON THE THEORY OF THE NONLINEAR COMPTON EFFECT. Kronig, R.; Pais, J. A. (Technological Univ. of Delft, Netherlands). Ark. Fys. Seminar Trondheim, No. 3, (1967).

The intensity distribution of the quadratic Compton effect is computed. It has the interesting feature, due to the magnetic moment of the electron, of differing essentially from the classical one for a point charge, even in the limit of very small frequencies. (auth)

27017 THEORETICAL CALCULATION OF THE RYDBERG STATES OF THE OXYGEN MOLECULE. LeClercq, J. (Centre de Mecanique Ondulatoire Appliquee, Paris). Ann. Astrophys., 30: 93-9(Jan.-Feb. 1967). (In French).

By use of LCAO-MO-SCF functions, the energy levels were computed for the first terms of the oxygen molecule's Rydberg series of symmetry $^3\Sigma_u^-$ and $^3\pi_u$ converging to different known states of O_2^+. Comparison of these calculations with experimental results allowed verification of the classification of this series, assignment of certain properties to the observed levels, and prediction and localization of some as yet unobserved Rydberg states. If it is assumed that the energy of the $^2\Sigma_g^-$ state arising from the same configuration as the $^4\Sigma_g^-$ state is the energy of the as yet unobserved limit x of the V and W Rydberg series, theoretical calculations of the first terms of the Rydberg series converging toward this $^2\Sigma_g^-$ state give results comparable to the experimental results for the series whose limit is x. This seemed to confirm the hypothesis that the x state is of symmetry $^2\Sigma_g^-$. (BBB)

Cosmic Radiation

Refer also to abstracts 26955, 27284, and 27301.

27018 (MIT-2098-299, pp 1-15) COSMIC RAY GROUP. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science).

Research topics briefly reported on include x-ray astronomy, high-energy gamma-ray astronomy, infrared astronomy, development of a lithium-drifted Ge detector for gamma-ray lines, interplanetary plasma, BASJE Cherenkov light experiment, and search for quarks in cosmic radiation. (W.D.M.)

27019 (N-67-11376) THE ENERGY SPECTRUM OF COSMIC-RAY HEAVY NUCLEI OF CHARGE Z > 10 DURING A SOLAR QUIET TIME IN JULY 1961. Durgaprasad, N. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Aug. 1966. 31p. (NASA-TM-X-55602; X-611-66-366). CFSTI $3.00 cy, $0.65 mn.

The energy spectrum of heavy nuclei was determined in the energy interval from 200 to 700 MeV/nucleon, using a stack of nuclear emulsions, on a balloon flown from Fort Churchill, Manitoba. The charge and energy spectra were obtained principally from tracks of particles that ended in the detector by a combination of range and δ-ray density measurements. A second charge estimation for particles which stop in the emulsion was made from integral δ-ray counts as a function of range. The energy spectrum was extended up to 700 MeV/nucleon by taking into consideration also the tracks that pass through or interact within the stack using a combination of δ-ray density and multiple scattering measurements that determine the charge and energy of the nuclei. This energy spectrum was combined with the spectra measured for protons and helium nuclei in the same flight and with similar data obtained during 1963 with a view of arriving at a better understanding on the propagation of cosmic-ray nuclei in source regions, interstellar space, and solar system. (auth)

27020 (N-67-12219) MEASUREMENT OF THE CHARGED SPLASH AND RE-ENTRANT ALBEDO OF THE COSMIC RADIATION. Dev Verma, Satya (Chicago Univ., Ill. Enrico Fermi Inst. for Nuclear Studies). July 1966. 38p. (NASA-CR-79516; EFINS-66-71). CFSTI $3.00 cy, $0.65 mn.
Thesis.

A study of the flux and energy spectrum of the proton and electron components of the splash and re-entrant cosmic-ray albedo has been made at balloon altitude. The energy spectrum and the flux of the splash and the re-entrant albedo protons have been measured in the energy range from 37 to 334 MeV, at an atmospheric depth of about 4 g/cm^2. The two spectra agree within experimental errors and can be represented by the power laws. (auth)

27021 RECEIVER WITH AUTOMATIC SEARCHING FOR THE INTERFERENCE-FREE RECORDING OF THE SOLAR FLARE EFFECTS AND BLACKOUT BY THE COSMIC NOISE METHOD. Ludwig, G. (Univ., Kiel). Z. Angew. Phys., 22: 8-14(1966). (In German).

The interference-free recording of solar-flare effects and polar blackouts applying the cosmic-noise method is considered. The ionospheric effects which are to record and the interferences which are to avoid, are described, and a method is given, how to separate both with high accuracy (receiver with automatic frequency searching). The application of this method to a cosmic-noise-recording receiver leads to an indication of interference-signal with a sensitivity corresponding to the recording sensitivity. (auth)

27022 MEASUREMENT OF THE ULTRARADIATION γ SPECTRA FROM 0.2 TO 12 GeV AT AN ATMOSPHERIC DEPTH OF 26 g/cm^2. Koehn, Diederich; Roehrs, Klaus (Univ., Kiel). Z. Naturforsch., 22a: 138-9(Jan. 1967). (In German).

The integral and differential energy spectra of the secondary cosmic-ray photons in the energy range 0.2 to 12 GeV are measured at an atmospheric depth of 26 g/cm^2 using a balloon-borne lead-scintillator-sandwich spectrometer. The shape of the integral spectrum can be approximated by a power law $I_\gamma(> E) \sim E^{-0.85\pm0.05}$ between 0.2 and 8 GeV. The production rate of photons in the upper atmosphere is derived. A comparison is made with the results of other authors. (auth)

27023 PRIMARY COSMIC-RAY ELECTRON SPECTRUM NEAR SOLAR MINIMUM. L'Heureux, Jacques (Univ. of Chicago). Astrophys. J., 148: 399-414(May 1967).

Two balloon flights were made from Fort Churchill, Manitoba, in the summer of 1965 to continue an investigation of the flux and energy spectrum of the primary cosmic-ray electron component. The spectrum was studied for energies from 20 MeV to 5.5 BeV. Above 1.2 BeV, the differential energy spectrum can be represented by a power law of the form $dJ/dE = (48 \pm 15) E^{-(2.1\pm0.3)}$ electrons m^{-2} sec^{-1} sterad^{-1} BeV^{-1}. For energies below 1 BeV the spectrum becomes flatter (slope $\gamma \lesssim 1.6$). Between 20 and 270 MeV the total flux rather than the differential flux was measured. Its value is 180 ± 30 electrons m^{-2} sec^{-1} sterad^{-1}. A comparison of the results with data at higher energies obtained by other authors indicates that the spectrum is steeper above 10 BeV (γ = 2.45). The data are also compared with the results obtained from the observations of the non-thermal radio emission from high galactic latitudes. The electron energy spectrum obtained in this experiment is, for energies greater than 1 BeV, in agreement with the spectrum of galactic electrons as derived from the radio-noise measurements. Below 1 BeV the measured electron energy spectrum is flatter than would be predicted on the basis of the radio-noise frequency spectrum for frequencies less than 50 Mc/s (corresponding to electrons below 1 BeV). This might be an indication that solar modulation, even near solar minimum, affects the electron spectrum measured at Earth. The measurements were carried out using a counter system. A total absorption lead-glass Cherenkov counter was used to obtain the energy of the electrons. Low-energy protons were rejected by the use of a gas Cherenkov threshold counter. Guard counters served to identify high-energy protons. (auth)

27024 ORIGIN OF ULTRARELATIVISTIC COSMIC RAY PARTICLES. Layzer, David (Harvard Coll. Observatory, Cambridge, Mass.). Nature, 214: 772-6(May 20, 1967).

A mechanism is proposed to explain how cosmic rays and fast electrons in non-thermal radio sources originate. The theory develops from Fermi's suggestion that charged particles gain energy through successive encounters with moving magnetic fields. Considerations of the geometry of cosmic magnetic fields and the state of motion of the plasma indicate how magnetic energy may be converted into kinetic energy of fast particles and how such particles may be later released. (auth)

27025 ANOMALOUS TIME VARIATION IN COSMIC-RAY NEUTRON INTENSITY CAUSED BY ATMOSPHERIC PRESSURE DEVIATION DUE TO HIGH WIND. Kawasaki, Shinkichi (Inst. of Physical and Chemical Research, Tokyo). Rika Gaku Kenkyusho Hokoku, 42: 60-7(May 1966). (In Japanese).

The velocities of wind were measured at the top of Mt. Norikuradake (2770 m above sea level, at geographical 137° 3.3′ E lat. and 36° 07′ N long., with average atmospheric pressure 720 mb). It was found that the difference between the atmospheric pressure within the (neutron) observatory and the true (outside) atmospheric pressure was largely influenced by the prevalent wind velocity, and this relation was examined. A study was made on the apparent time variation in neutron intensity, due to an inadequate correction for the deviation of atmospheric pressure caused by wind velocity. When the wind velocity exceeded 10 m/sec, the neutron intensity was reduced by over about 0.3%. Accordingly, if a neutron-measuring device, larger than the existing standard one, is to be installed, it is necessary to remove the error in the measurement of atmospheric pressure due to a wind; its countermeasures are also described. (NSA of Japan).

27026 COHERENT PRODUCTION OF PARTICLES IN COLLISIONS OF 200-GeV PIONS WITH EMULSION NUCLEI. Czachowska, Z.; Gierula, J.; Krzywdzinski, S.; Miesowicz, M.; Rybicki, K.; Wolter, W. (Inst. of Nuclear Research, Krakow). Nuovo Cim. (10), 49A: 303-5(May 21, 1967).

Multiplicity distributions were obtained for events found in a systematic scanning along secondary tracks in 36 jets initiated by primary cosmic-ray nucleons of energy higher than 10^{12} eV. 144 secondary interactions were found, with a mean energy of 200 GeV. Evidence was found for coherent particle production by 200-GeV pions; the results indicated that the cross section for this process is higher at this energy than at observed accelerator energies. (L.B.S.)

27027 INVESTIGATION OF THE INTENSITY AND SPECTRAL COMPOSITION OF THE MOON'S GAMMA-RADIATION AT THE LUNA-10 AUTOMATIC STATION. Vinogradov, A. P.; Surkov, Yu. A.; Chernov, G. M. Dokl. Akad. Nauk SSSR, 170: 561-4(Sept. 21, 1966). (In Russian).

A 32-channel γ spectrometer was used for determining the intensity and spectral composition from lunar rocks at the Luna-10 space station, launched on April 3, 1966 on a Moon-centered orbit. In view of the absence of an absorbing atmosphere, the measurements were carried out directly while the spaceship was in orbit. The γ emission recorded is probably due to thorium and uranium, their decay products, and to the naturally radioactive ^{40}K. The lunar γ spectra were found to differ markedly from terrestrial γ radiation. Most of the γ rays are assumed to be created by interaction of cosmic radiation with the lunar material and by the decay of the thus generated radioisotopes; less than 10% of the radiation is estimated to be due to the presence of K, U, and Th. In addition to nuclear reactions leading to the emission of γ quanta, decay processes of π mesons and bremsstrahlung of electrons of protons also play an important role in the emission of the characteristic γ quanta. However, no conclusion can be reached at this time concerning materials of meteoritic origin. (TTT)

Direct Energy Conversion

27028 (ARL-67-0008) RESEARCH ON POWER GENERATION ELECTROGASDYNAMIC ENERGY CONVERSION. Final Technical Report, April 15, 1965-April 15, 1966. Brandmaier, Harold E.; Dimmock, T. Herbert; Kahn, Bernard (Curtiss-Wright Corp., Wood-Ridge, N. J. Wright Aeronautical Div.). Jan. 1967. Contract AF 33(615)-2791. 167p. (WAD-R-430-F). CFSTI.

A closed-cycle electrogasdynamic power generator was developed. A voltage of one million volts at a current of 46 microamperes was indicated. The working fluid was a charged air–water aerosol. The pressure in the energy conversion channel was 47 atmospheres and the Mach number was 0.4. In these studies, it was found that generator voltage, current, and power increased with pressure and decreased with channel length. Breakdown current values under high-pressure flow conditions were below those found statically and below those found in the supersonic open cycle generator. In a separate open-cycle electrogasdynamic generator, at Mach 2, the output was related to the condensation phenomena in the nozzle. Load characteristics and radial and axial potential profiles were measured and these agreed qualitatively with the two-dimensional theory developed in this program. This theory also showed that fully developed charge distributions predicted by early investigations are not obtained in conversion channels of practical dimensions. The program included studies of charged particles mobility measuring techniques and laser beam diagnostics of the aerosol charge carriers. (auth)

27029 (BMwF-FBK-66-29(Pt.2)) HERSTELLUNG UND UNTERSUCHUNG VON KARBIDISCHEN HEIZERN FUER EINEN MIT KERNENERGIE BETRIEBENEN THERMIONISCHEN KONVERTER. TEIL II. (Production and Investigation of Carbide Heaters for a Thermionic Converter Operating with Nuclear Energy. Part II). Kadner, M.; Merz, D.; Oberender, W.; Schuster, K. (Battelle Institut e. V., Frankfurt am Main (West Germany)). Sept. 1966. 24p. (In German). Dep. mn.

Sintered specimens consisting of zirconium carbide as matrix material and embedded coated particles were heated in vacuo to temperatures around 1800°C for 100 hours or more. The after-heating findings are discussed. (auth)

27030 (LA-DC-8575) XENON PRESSURE INDUCED CHANGES IN ELECTRON DENSITY AND TEMPERATURE IN A CESIUM PLASMA DIODE. Reichelt, W. H. (Los Alamos Scientific Lab., N. Mex.). [1966]. Contract W-7405-eng-36. 4p. (CONF-670320-1). Dep. CFSTI.

From 27th Annual Conference on Physical Electronics, Cambridge, Mass.

Spectrographic observations were made on an operating cesium thermionic diode with xenon additions. Free electron temperatures and densities were determined at three points in the interelectrode gap; the xenon pressure was 0, 25, and 60 torr. The effect of xenon on the current–voltage curve was found to be pronounced. Electron densities and temperatures are presented for diode currents of 9 and 10.2 A. It is concluded that the quasi-equilibrium condition in the plasma is not changed by xenon additions. (D.L.C.)

27031 (N-67-12169) SOLAR THERMIONIC GENERATOR DEVELOPMENT. **Quarterly Report, June 1–September 3, 1966. (Thermo Electron Engineering Corp., Waltham, Mass.). Sept. 1966. Contracts NAS7-100; JPL-951263. 50p. (NASA-CR-80135; TE-20-67; QR-3). CFSTI $3.00 cy, $0.65 mn.**

The third and fourth thermionic converter engineering models, T-203B and T-204, were fabricated and tested. Both converters exhibited substantially better performance than the previous models. Converter T-204 was able to deliver an output of 29 amperes at 1.0 volt at 1724°C cavity temperature and in steady state, in spite of the lowered emitter temperature of 1961°K caused by the higher thermal resistance of a solid rhenium emitter. The fabrication of T-204 included the test of an all-rhenium emitter structure which was successfully cycled through 10 fast thermal cycles to 1780°C at the cavity. Furthermore, chromium carbide and zirconium carbide were evaluated as possible alternate radiator coatings to chromium oxide, but both materials were found to have only 60% of the emissivity of chromium oxide. (auth)

27032 (AD-650802) MAGNETOHYDRODYNAMIC GENERATOR. Garbuzov, V. N.; Parkhomenko, V. A.; Strizhak, V. E. Translated from Russian Patent No. 175583. 8p. (FTD-HT-66-602). CFSTI.

A magnetohydrodynamic conduction-type generator that uses the Hall effect is described. The generator channel is constructed of alternating metal and insulating frames arranged at an angle to the generator axis to improve operational dependability of the generator. (auth)

27033 (NP-tr-1526) CHARACTERISTICS OF HIGH TEMPERATURE TYPE SOLID ELECTROLYTE FUEL CELLS EMPLOYING CeO_2–La_2O_3 SYSTEM SOLID SOLUTIONS. Takahashi, T.; Ito, K.; Iwahara, H. Translated by S. G. Brickley (Atomic Energy Research Establishment, Harwell, Eng.), from Denki Kagaku, 34: 205-9(1966). 18p. Dep. mn. **CFSTI $3.00 cy, $0.65 mn. JCL $1.60 fs, $0.80 mf.**

The construction of a high-temperature solid electrolyte fuel cell employing $CeO_2-La_2O_3$ solid solutions is reported. (J.H.M.)

27034 THERMIONIC EMITTERS CONSISTING OF BaO–UO_2 DISPERSED IN A TUNGSTEN MATRIX. **Gifford, Fay E.; Hill, Robert F. (General Motors Corp., Warren, Mich.). J. Appl. Phys., 38: 2261-8(Apr. 1967).**

Thermionic emitters fabricated with various concentrations of BaO and UO_2 dispersed in tungsten have been operated at temperatures up to 1400°C. A tentative phase diagram for the BaO–UO_2 system has been constructed from microstructure and x-ray analysis. Electron-emission studies, emitter-life tests, and barium-transpiration studies have been conducted on eleven different BaO–UO_2 tungsten compositions. The emission studies have indicated current-density capabilities of 10 A/cm^2. Work-function measurements at 1100°C on the various emitters tested ranged from 2.03 eV for the high-barium-content samples to 2.56 eV for the low-barium-content samples. The barium transpiration rate of the emitters was evaluated for various barium contents and compositional forms. For a given quantity of barium, the transpiration rate was lower from the $BaUO_3 + UO_2$ system than from the $BaUO_3$ + BaO system. At a temperature of 1200°C one type of BaO–UO_2 tungsten material had a transpiration rate of 20 μg/cm^2 hr. (auth)

27035 RADIAL SPACE CHARGE FIELDS IN ELECTROFLUID DYNAMIC GENERATORS. Brandmaier, H. E. (Curtiss-Wright Corp., Wood-Ridge, N. J.). AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 5: 1037-9(May 1967).

A simplified analysis is presented from which the maximum contribution of the radial electric field to generator performance can be estimated. (M.H.R.)

27036 MAGNETOHYDRODYNAMIC POWER GENERATION USING A BIFLUID LIQUID-METAL GENERATOR. **Sense, Karl A.; Gelb, George H. (TRW Systems, Redondo Beach, Calif.). AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 5: 862-7 (May 1967).**

Lithium–cesium bifluid cycles using a direct-current liquid-metal magnetohydrodynamic generator were analyzed for a heat-source temperature of 1366°K (SNAP-50 reactor). Having the separator downstream of the generator instead of upstream, and hence operating with two-phase flow through the generator, has two distinct advantages. First, a significantly higher load voltage can be achieved. Second, superior cycle efficiency results. Thermodynamic considerations show that, including friction losses, an overall cycle efficiency of 13% can be obtained. However, operation at high cycle efficiencies requires that the two-phase flow through the generator has high void fraction. Tolerable fluid void-fraction limits for adequate electrical conductivity are being determined experimentally. Expressions are developed based on a simplified model of the two-phase constant-velocity generator relating its geometry, electrical characteristics, magnetic field strength, and average electrical conductivity of the fluid. Using these expressions, calculations were carried out for a 30-kWe system. It is shown that, as the electrical conductivity of the two-phase fluid decreases to very low levels, the use of a superconducting magnet becomes essential. Under these conditions, the output voltage is increased significantly. This is important for direct-current liquid-metal MHD generator systems, since such systems suffer from very low voltage outputs resulting in severe power conditioning problems. (auth)

27037 SERIES-EXCITED EXPLOSIVELY DRIVEN MHD GENERATOR. **Frankenthal, Shimshon (American Science and Engineering Inc., Cambridge, Mass.). AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 5: 858-61(May 1967).**

A lumped-parameter (slug) model of the explosively driven MHD pulse generator is treated. The modes of operation of the device are cataloged. An analytical expression is derived for the dependence of the conversion efficiency of the device on its parameters: the magnetic Reynolds number, the load-to-channel inductance ratio, and the ratio of initial magnetic and kinetic energies. Some aspects of this dependence are studied in detail. It is shown that the load inductance establishes an upper bound on the energy gain (energy delivered/initial magnetic energy), and also determines the degree to which the magnetic excitation can be reduced without serious sacrifice of efficiency. Performance measures for the device are defined. The role played by the ratio of the load and slug resistances in the optimization of the performance is discussed. (auth)

27038 FLUID METAL MHD-STEAM BINARY CYCLE POWER GENERATION. **Prem, L. L.; Wang, T. C. (Atomics International, Canoga Park, Calif.). Proc. Amer. Power Conf., 28: 282-92(1966).**

A review is presented of Atomics International's fluid metal MHD concept, and the MHD–steam binary cycle is described. The results of the experimental program aimed at demonstrating this concept are presented in some detail. An evaluation of plant economy based upon the proposed binary cycle is also outlined. (M.O.W.)

27039 AUXILIARY IONIZATION: A LOW CONDUCTIVITY APPROACH IN CLOSED CYCLE MHD RESEARCH. **Braun, J. (Aktiebolaget Atomenergi, Studsvik, Sweden). Plasma Phys., 9: 93-4(Jan.-Feb. 1967).**

The present position of the high conductivity approach to MHD power generation is summarized, and the use of low conductivity methods as possible alternatives is discussed. (UK)

27040 INFLUENCE OF THE ADDED NOBLE GAS ON THE ANALYTICAL CORRELATION OF CESIUM THERMIONIC DIODE PARAMETERS. **Musa, G. (Inst. of Physics, Bucharest). Int. J. Electron., 21: 583-591(Dec. 1966).**

An analytical correlation is derived including the cesium diode parameters and the added noble gas pressure. The relations obtained are compared with experimental data obtained from output characteristics reported for a Cs–Xe mixture by Kaplan and Merzenich (1964). The agreement is quite satisfactory. The equations are useful for ignited mode thermionic diode performance prediction and optimization. The derived results are valuable for low-voltage arc mode when the electron collision ionization of cesium atoms is considered as dominant ion generation mechanism. (auth)

27041 ELECTRICITY DIRECTLY FROM ATOMIC ENERGY. **Pedersen, E. Storm (Danish Atomic Energy Research Establishment, Risoe). Ing. Bygningsv., 62: No. 4, 81-5(Apr. 1967). (In Danish).**

A description is given of how electricity now can be produced directly from atomic energy without the use of pumps, turbines, etc. This is possible by using magnetohydrodynamics (MHD), thermoelectric effect, and thermionics in connection with a nuclear reactor or radioisotopes as heat sources. The main principles and some of the problems to overcome if these methods are to become important as power sources are also explained. (auth)

27042 SUBATMOSPHERIC MAGNETOHYDRODYNAMIC GENERATOR. **(to Compagnie Generale d'Electricite). British Patent 1,070,445. June 1, 1967. Priority date Sept. 6, 1963, France.**

An open-circuit MHD generator working at subatmospheric pressures is designed to solve the problem of driving out gases from the generator. In the design, the MHD conversion chamber opens to the atmosphere through a speed reducing chamber which is provided with an ejector feeding a jet of compressed gas into the stream of combustion gases. Several embodiments of the design are described. (D.L.C.)

Fluid Physics

Refer also to abstracts 27028 and 27110.

27043 (NYO-3326-15) PROPAGATION OF DENSITY FLUCTUATIONS IN DENSE MONATOMIC FLUIDS. **Ranganathan, Subramanian** (Cornell Univ., Ithaca, N. Y. Dept. of Engineering Physics). Feb. 1967. Contract AT(30-1)-3326. 113p. Dep. CFSTI.

Thesis.

The Fourier transform S(K,ω) of the time-dependent density-density correlation function G($\bar{r}$,t) has been calculated using the linearized Boltzmann equation in the case of dilute gases and the Enskog and the Vlasov equation in the case of dense fluids. The approach consists of solving an initial value problem for a small density disturbance and identifying G($\bar{r}$,t) as the velocity integral of the distribution function. In the case of Maxwell molecules for a dilute gas, the exact results of S(K,ω) have been compared with those of the Navier–Stokes and Burnett equations of hydrodynamics. The exact numerical solutions of S(K,ω) for Maxwell molecules have also been compared with the experiments on Brillouin scattering from dilute gases. The sound dispersion phenomena in dilute gases are reviewed and extended and it is shown that the observed sound dispersion, even to the lowest order, is very sensitive to the way it is measured. To be able to solve the Enskog equation for S(K,ω), the interactions terms have to be approximated. The calculations have also been done with corrections to the first approximations and the results compared. Its application to Brillouin scattering and neutron scattering has also been discussed. To apply the Vlasov equation to classical fluids, the intermolecular potential in the equation has to be replaced by the direct correlation function. The results are compared with the experimental S(K,ω) observed through neutron scattering in liquid lead and there is seen to be a qualitative agreement. It also predicts the propagation of a collisionless sound at some wave numbers. The effect of including collisions in the Vlasov equation has also been investigated. A numerical comparison, in the structureless regime, between the Enskog equation and the Vlasov equation with collisions has also been made. (auth)

27044 ON THE FLOW OF AN ELECTRICALLY CONDUCTING, INCOMPRESSIBLE FLUID NEAR AN ACCELERATED PLATE IN THE PRESENCE OF A PARALLEL PLATE, UNDER TRANSVERSE MAGNETIC FIELD. **Soundalgekar, V. M.** (IIT, Bombay). Proc. Indian Acad. Sci., Sect. A, 65: 179-87(Mar. 1967).

Hydromagnetic flow is considered of a conducting, incompressible viscous fluid near an accelerated flat, nonconducting plate, in the presence of another parallel plate, when there is a transversely applied magnetic field. The induced magnetic field is neglected in comparison with the applied magnetic field. Laplace transform techniques are used. The equations are integrated by applying residue principle, and expressions for velocity profiles and skin-friction at both plates are derived for different values of Hartmann number M. It is observed that, with the increase of the value of the Hartmann number M, the velocity profiles are flattened, the shear stress at the stationary plate decreases, as the value of the time T and Hartmann number M increases, but the shear stress at the accelerated plate increases directly in proportion with the increase in time and Hartmann number. (auth)

27045 GENERAL THREE-DIMENSIONAL WAVE PROPAGATION IN NONEQUILIBRIUM MAGNETOGASDYNAMICS. **Bhutani, Om Prakash; Sharma, Ramsewak** (Indian Inst. of Tech., Kharagpur, India). J. Math. Anal. Appl., 18: 199-217(May 1967).

Broer's rate equation is used to study the propagation of small disturbances in general three-dimensional unsteady nonequilibrium magnetogasdynamics. An exponential solution of the type exp $[2\pi/\lambda(n \times r - v_0 t)]$ is assumed, and a fifth degree algebraic equation for v_0 is derived. Explicit solutions for the cases of no magnetic field and a transverse magnetic field are obtained. For showing the influence of the various parameters on the propagation properties in the general case, the velocity phase diagram is drawn for different values of the parameter $\delta = k^2 c_A^2$ where k is the relaxation parameter and c_A is Alfvèn's speed. Results are also obtained concerning the stability, the decaying factor, and the diffusion coefficient of the waves. (A.G.W.)

27046 FLUCTUATING BOUNDARY LAYER ON A MAGNETIZED PLATE. **Chawla, Sahib Singh** (Indian Inst. of Tech., Kharagpur). Proc. Cambridge Phil. Soc., 63: 513-25(1967).

The MHD laminar boundary layer on a magnetized plate, when the magnetic field oscillates in magnitude about a constant nonzero mean, is analysed. For low-frequency fluctuations, the solution is obtained by a series expansion in terms of a frequency parameter, while for high frequencies the flow pattern is of the "skin-wave" type unaffected by the mean flow. In the low-frequency range, the phase lead and the amplitude of the skin-friction oscillations increase at first, and then decrease to their respective "skin-wave" values. On the other hand, the phase angle of the surface current decreases from 90° to 45° and its amplitude increases with frequency. (auth)

27047 SOME MAGNETOHYDRODYNAMICS OF A THIN BODY IN OBLIQUE FIELDS. **Greenberg, Paul** (London Univ., New Cross, Eng.). AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 5: 1047-9(May 1967).

The motion of a compressible, inviscid, perfectly conducting fluid was considered by the method Stewartson used for an incompressible fluid. (M.H.R.)

27048 SUPPRESSION OF TURBULENCE BY A UNIFORM MAGNETIC FIELD. **Moffatt, H. K.** (Cambridge Univ., Eng.). J. Fluid Mech., 28: 571-92(1967).

The suppression of initially isotropic turbulence by the sudden application of a uniform magnetic field is considered. The problem is characterized by three dimensionless numbers, a Reynolds number R, a magnetic Reynolds number R_m, and a magnetic interaction parameter N. It is supposed that $R \gg 1$, $R_m \ll 1$, and $N \gg 1$. There are two important time scales, t_d, a time characteristic of magnetic suppression, and $t_0 = Nt_d$, the turn-over time of the turbulent energy-containing eddies. For $0 < t \ll t_0$ the response of the energy-containing components of the turbulence to the applied field is linear and the time dependence of the kinetic energy density K(t) and magnetic energy density M(t) are analysed. There are essentially two distinct contributions to each from two domains of wave-number space D_1 and D_2. In D_1 the response is severely anisotropic, while in D_2 it is nearly isotropic. The relative importance of the contributions $K_1(t)$ (from D_1) and $K_2(t)$ (from D_2) to K(t) depends on the value of the Lundquist number $S = (NR_m)^{½}$. If $S \ll 1$, then $K_1(t)$ dominates for all $t \lesssim t_0$ and $K(t) \propto t^{-½}$ for $t_d \ll t \ll t_0$. If $S \gg R_m^{-2}$, then $K_2(t)$ dominates, and $K(t) \propto t^{-½}$ for $R_m t_0 \ll t \ll t_0$. If $1 \ll S \ll R_m^{-2}$, then a changeover in the dominant contribution occurs when $t = O(S^{½} R_m) t_0$. Analogous results are obtained for the magnetic energy density. (auth)

27049 FLOWS BEHIND UNSTEADY MAGNETOGASDYNAMIC SHOCKS. **Ram, Rishi** (Univ. of Allahabad, India). Ann. Soc. Sci. Brux. Ser. 1, 81: 87-96(1967).

The condition for existence and uniqueness of flows behind a magnetogasdynamic shock in unsteady plane motion was obtained by applying the Cauchy–Kowaleski theorem direct to the basic equations of motion without transforming them to normal forms. Two very interesting linear relations between vorticity and current density generated behind the shock were investigated. From these two linear relations it is shown that vorticity and current density behind the shock can be determined uniquely if and only if the condition for existence and uniqueness of flow is satisfied. In this process it was established that the vorticity generated behind a magnetogasdynamic shock is no longer derivable purely from the dynamical relations as in nonconducting gases. The equation of energy is essentially needed in the process. It is also shown that the gradients of flow and field parameters behind the shock can be uniquely determined under the same condition. (auth)

27050 LAMINAR BOUNDARY-LAYER HEAT TRANSFER FROM A PARTIALLY IONIZED MONATOMIC GAS. **Back, L. H.** (California Inst. of Tech., Pasadena). Phys. Fluids, 10: 807-19 (Apr. 1967).

Laminar boundary-layer heat transfer from a partially ionized monatomic gas to a highly cooled wall with no applied external electric or magnetic fields is analyzed by the similarity solution approach. The gas is assumed to be electrically neutral with ambipolar diffusion by ion–electron pairs. In addition, equal electron and atom–ion temperatures are assumed, and sheath effects are not considered. From existing perfect gas similarity solutions, the number of parameters that need to be investigated is reduced to those directly related to ionization effects. Solutions for the limiting cases of a large diffusion rate compared to the net production rate of ions and for local equilibrium are obtained for a range of Prandtl and Lewis numbers. An approximate prediction method that includes variable property considerations is then suggested to account for variable free-stream velocity and ionization effects in a flow over a highly cooled wall. (auth)

27051 GROWTH OF TURBULENT MAGNETIC FIELDS. **Kraichnan, Robert H.; Nagarajan, S.** Phys. Fluids, 10: 859-70 (Apr. 1967).

The evolution of a weak, random initial magnetic field in a highly conducting, isotropically turbulent fluid is discussed with the aid of the exact expression for initial growth of the magnetic energy spectrum. Equipartition arguments, the vorticity analogy, and the known turbulence approximations all are found inadequate for predicting whether the magnetic energy eventually dies away or grows exponentially. This is true for any ratio of magnetic diffusivity λ to kinematic viscosity ν. The possibilities of eventual growth and eventual decay are therefore both admitted, and, for each, the shape of the magnetic-energy spectrum in the case $\lambda \gg \nu$ is estimated by simple dynamical arguments. If there is growth, it is concluded that the magnetic spectrum below the Ohmic cut-off eventually reaches equipartition with the kinetic-energy spectrum roughly in the fashion predicted by Biermann and Schlüter, with the principal exceptions that the spectrum of kinetic energy in the equipartition inertial range evolves to the form $k^{-3/2}$ and that equipartition is maintained, with rapidly falling spectrum, through part of the Ohmic dissipation range. The evolution of the magnetic spectrum in the weak-field $\lambda \gg \nu$ regime is also computed numerically with a simplified transfer approximation suggested by the Lagrangian-history direct-interaction equations. This calculation turns out to yield an eventual very weak exponential growth of magnetic energy. (auth)

27052 STABILITY OF RELATIVISTIC MAGNETOHYDRODYNAMIC SHOCK WAVES. Lessen, Martin; Deshpande, Narayan V. (Univ. of Rochester, N. Y.). Phys. Fluids, 10: 782-5 (Apr. 1967).

The stability of relativistic shock waves in an infinitely conducting plasma containing an applied magnetic field parallel to the plane of the shock wave is studied with respect to a disturbance with a wave number vector perpendicular to the magnetic field. It is concluded that such disturbances are stable. (auth)

27053 COMPRESSIBLE MAGNETOGASDYNAMIC FREE JET. Smith, David C.; Cambel, Ali Bulent (Northwestern Univ., Evanston, Ill.). Phys. Fluids, 10: 774-81(Apr. 1967).

The problem of an electrically conducting, compressible, viscous free jet in the presence of transverse magnetic and electric fields is solved analytically by a perturbation technique. The velocity and temperature profiles are expanded about the nonmagnetic jet solutions, the expansion parameter being the magnetic interaction parameter. The first-order perturbation solution is obtained in closed form for both the velocity and temperature profiles when a transverse magnetic field interacts with the free jet. Finally, the velocity profiles are obtained in closed form for an electric field transverse to both the jet axis and the magnetic field. (auth)

Geophysics

27054 (NASA-CR-729) OPTICAL RADAR MEASUREMENTS OF THE ATMOSPHERE. Lawrence, J. D. Jr.; Crownfield, F. R. Jr.; McCormick, M. P. (College of William and Mary, Williamsburg, Va.). Apr. 1967. 54p. CFSTI $3.00 cy, $0.65 mn.

Several aspects of these investigations are discussed. Estimates of the optical radar returns from various altitudes are considered, and these are used to discuss signal-to-noise ratios and to optimize various system parameters. Experimental equipment is described, and sample data are presented and discussed. (J.H.M.)

27055 (TID-23760, pp 63-8) GEOPHYSICAL RESEARCH. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics).

Further research developments are briefly reported on: high magnetic fields, upper atmospheric physics, and possible relation between dust and rainfall. (M.O.W.)

27056 (NASA-TT-F-463) INFLUENCE OF THE EARTH'S MAGNETIC FIELD ON THE DIURNAL VARIATION OF f_0F2 (FOURIER ANALYSIS). Eyfrig, R. Translated from paper Presented at the International Radio Union, 15th General Assembly, Munich, Germany, September 5–19, 1966. 10p. (CONF-660950-1). CFSTI.

A brief comparison of available studies of the influence of the earth's magnetic field on the diurnal variations of the F2 ionosphere layer is given to demonstrate that optimum data on the physical control effects are obtained by a Fourier analysis of the diurnal variations of f_0F2. The analysis was extended over two months during the sunspot maximum in June and December 1958. The analysis indicates that the permanent maximum of spread-F is located east of the magnetic pole, close to Foxe Basin. A diagram of the numerical values for the phase angle of the first harmonic of f_0F2 indicates that much higher phase angles are observed in the western declination zones than in the eastern zones. An influence of the magnetic declination on the amplitudes of the first harmonic is substantiated. The maximum of the fundamental a_0 at the magnetic pole is attributed to electrons entrained over the lines of force of the earth's field or to corpuscular radiation. (auth)

27057 THEORY OF WHISTLER DIAGNOSIS OF PLASMA CONCENTRATION IN THE EXOSPHERE. Gul'el'mi, A. V. (Inst. of Terrestrial Physics, Moscow). Geomagn. Aeronomy (USSR) (Engl. Transl.), 6: 598-600(1966).

Translated from Geomagn. Aeronomiya, 6: 778-80(1966).

A formula is obtained for computing plasma concentration from the dependence of the delay time of noise frequency on the parameter of a whistler's trajectory. (J.H.M.)

27058 ACOUSTIC–GRAVITY WAVES IN THE UPPER ATMOSPHERE DUE TO A NUCLEAR DETONATION AND AN EARTHQUAKE. Row, Ronald V. (Sylvania Electronic Systems, Waltham, Mass.). J. Geophys. Res., 72: 1599-1610(Mar. 1, 1967).

The large nuclear detonation low in the atmosphere over Novaya Zemlya on October 30, 1961, caused a traveling ionospheric disturbance observed widely on high-frequency radio sounders. A similar but much weaker disturbance was noted after the great Alaskan earthquake of March 1964. Both disturbances exhibit an abrupt onset traveling at speeds appropriate to sound waves above 100-km altitude and an oscillatory long-period tail. Both these properties are shown to be a characteristic of the propagation of a disturbance from a localized impulse source in an unbounded dissipationless, planar, nonrotating, gravitationally stratified isothermal neutral atmosphere. The theory for pulse propagation in such an atmosphere is developed, including a simple closed-form approximation appropriate to long-period components of the motion (i.e., periods greater than the Brunt period), which exhibit the major features of the observations. (auth)

27059 ANALYTIC APPROXIMATION FOR THE ELASTIC RADIATION FROM A CONTAINED UNDERGROUND EXPLOSION. Haskell, N. A. (Air Force Cambridge Research Labs., Bedford, Mass.). J. Geophys. Res., 72: 2583-7(May 15, 1967).

A simple analytic function involving only an exponential and a polynomial is found to give a rather good fit to the experimental curves of the reduced displacement potentials for nuclear explosions in four different mediums as given by Werth and Herbst. By using this function, the near field and radiation field terms in the total energy integral and the energy spectral density of the radiation field are evaluated in closed form in terms of simple algebraic functions. (auth)

27060 TOPOLOGICAL STUDY OF THE MOTION OF PARTICLES TRAPPED IN A MAGNETIC FIELD. Ray, Ernest C. (Goddard Space Flight Center, Greenbelt, Md.). Ann. Phys. (N. Y.), 42: 508-12(May 1967).

The drift motion of charged particles trapped in a magnetic field takes place along curves of J = constant, where J is the adiabatic integral invariant. These are closed curves in the cases usually thought of in connection with physical systems such as the Earth's radiation belts. An exploration of the possibility that there exist magnetic fields such that the curves J = constant are a family of spirals is reported. It is shown that a necessary condition for this to occur is that there exists a J = constant spiral surface on which $B = 0$, or each line of force lying in it has the property that a particle spiralling about it does not, on the average, drift off it, or J suffers a discontinuity as one crosses it. Whether any of these conditions in fact leads to the curves being a family of spirals is not discussed. It seems to be unlikely that any reasonable model of the earth's field possesses these properties. (auth)

27061 A FURTHER ANALYSIS OF OBSERVATIONS OF JUPITER'S DECAMETRIC RADIO NOISE FOR THE APPARITIONS OF 1960–1964. Gruber, G. M. (Rhodes Univ., Grahamstown, South Africa). Astrophys. J., 148: 541-6(May 1967).

An analysis of decametric radio noise data obtained by J. W. Warwick and his co-workers for the apparitions of 1960–1964 of the planet Jupiter is presented. The data are divided according to the 2-MHz interval in which the maximum frequency observed during a storm fell. In each of the intervals the relationship of the number of occurrences to System-III longitude and the position of Io from superior geocentric conjunction is investigated. "Percentage probability" calculations are also presented. (auth)

27062 HIGH TIME-RESOLUTION STUDIES OF JUPITER'S RADIO BURSTS. Gordon, M. A. (High Altitude Observatory, Climax, Colo.); Warwick, J. W. Astrophys. J., 148: 511-33(May 1967).

Observations of Jupiter's decameter radio bursts, taken with a new type of polarimeter between 24 and 36 Mhz on a 10-msec time scale, are described. With the 1000-foot Arecibo radio telescope Jupiter emission on 19 of 39 observing nights during the 1964 apparition was observed. One of these events contained fine structure in time due to Jupiter. An alternation of the polarization as a function of frequency was present throughout this event. A theoretical analysis of this polarization diversity as Faraday effect at Jupiter leads to a description of the emission region as having an electron density of 3×10^4 cm^{-3}, a magnetic field density of 13 gauss, and negligible collision damping—if the wave interaction takes place over a distance of 20 km. The fine structure may be due to an aperture of phase-coherent emitters. The origin and escape of the two characteristic modes necessary for Faraday effect are discussed. (auth)

27063 6-CM OBSERVATIONS OF JUPITER. Dickel, John R. (Univ. of Illinois, Urbana). Astrophys. J., 148: 535-40(May 1967).

Observations of Jupiter were made at 6 cm with the 140-foot radio telescope at the National Radio Astronomy Observatory. The results show a mean flux density of 10.8 F.U. (for an Earth-Jupiter distance of 4.04 a.u.) and a degree of polarization of 0.086. Assuming a polarization of 0.22 for the nonthermal component to the emission, the measurements suggest a value of 4.2 F.U. for the nonthermal contribution and a thermal contribution equivalent to a disk with a brightness temperature of 224°K. The variation of emission with Jovian rotation confirms previous findings about the inclination of the magnetic axis and the beaming of the nonthermal radiation. (auth)

27064 SOLAR AND GEOMAGNETIC EFFECTS ON UPPER ATMOSPHERIC TEMPERATURE. Chandra, S.; Khrishnamurthy, B. V. (Goddard Space Flight Center, Greenbelt, Md.). Nature, 214: 769-72(May 20, 1967).

Reference is made to controversy concerning the possible sources of heating of the upper atmosphere. Arguments have been presented for and against the existence of a heat source of corpuscular origin. In order to study the effect of solar extreme uv and corpuscular radiation, chosen parameters are the solar decimeter flux and the daily variations of geomagnetic activity on the ground. The former is believed to be a measure of extreme uv flux, and the latter a measure of the corpuscular activity of the sun. Statistical analysis shows that the temperature of the upper atmosphere (above 200 km) is strongly correlated with the solar 10.7-cm radiation, and that short-term temperature variations are strongly correlated with the geomagnetic index. (UK)

27065 SPORADIC E IN MIDDLE LATITUDES: A REPLY. Layzer, D. (Harvard Univ., Cambridge, Mass.). Nature, 214: 794(May 20, 1967).

This note refers to previous communications in Nature 213: 576(1967) and 214: 261(1967). (UK)

27066 INTER-RELATIONS AMONG THE UPPER ATMOSPHERE DISTURBANCE PHENOMENA IN THE AURORAL ZONE. Oguti, T.; Nagata, T. (Tokyo Univ.). Rep. Ionosphere Space Res. Jap., 15: 31-50(1961).

The relation between the maximum density of electrons in the sporadic E layer and auroral zenith luminosity was examined with reference to the luminosity of N_2^+, based on data obtained at the Syowa Station of the Japanese Antarctic Base. It was established that in an equilibrium state in the aurorae, the luminosity of λ5577 from an aurora in zenith is proportional to the square of the maximum electron density, with a proportional constant 5×10^{-10} kR/(electrons/cm^3)^2, such that $J(5577) = 5 \times 10^{-10}\ n_{max}^2$. The dependence of this proportional constant on the altitude of the disturbance was also examined. The dependence of effective thickness of an auroral display on altitude, which, in relation to the altitude dependence of the effective recombination coefficient, was found to result in only a small altitude effect on the proportional constant. The study was extended to the relation between the magnitude of horizontal disturbance vector (ΔH) in the geomagnetic field and auroral zenith luminosity. It was found that J(5577) is proportional to the square of ΔH in an equilibrium state, as in the $J(5577)$-n_{max} relation. It was concluded that a simple relation holds between ΔH and J(5577) such that $J(5577)$ in kR $= 3 \times 10^{-3} (\Delta H_{in\gamma})^2$, in the case of isolated bay disturbances, and that the relations for severe storms, giant pulsations, and short period pulsations can be interpreted by modification of this standard relation. (BBB)

Low-Temperature Physics

27067 (CONF-640108-1) PECULIARITIES OF PHASE TRANSITION IN ROTATING LIQUID HELIUM. Andronikashvili, E. L.; Bablidze, R. A.; Gujabidze, G. V.; Tsakadze, J. S. (Akademiya Nauk Gruzinskoi SSR. Institut Fiziki). 1964. 16p. Dep.

From 2nd All Union Conference on Theoretical and Applied Mechanics, Moscow, USSR.

Quantized vortices in helium II and their characteristics are discussed. Experiments were performed on the damping of vortices in the transition from rotating helium II to helium I. The experiments included sound attenuation measurements. The results lead to the following conclusions: there is an intermediate mode of motion which cannot be supercooled and which differs from the aligned system of vortex lines; with time, this mode gives way to oriented Onsager-Feynman's vortices. The vortex lines in helium II are connected with extremely long times of relaxation. (D.L.C.)

27068 (N-67-11324) THE CRYOGENIC GYROSCOPE PROGRAM AT JET PROPULSION LABORATORY. Final Report. Harding, John T. (Jet Propulsion Lab., Pasadena, Calif.). July 1, 1966. Contract NAS7-100. 29p. (NASA-CR-79872; JPL-TR-32-897). CFSTI $3.00 cy, $0.65 mn.

A technical account of the development of the superconducting gyroscope is presented. The program, which began with levitating a superconducting ball with a single coil, has advanced to the point where total drift as low as one degree per day had been obtained with a research model of the gyro. The principal problems encountered in the program are namely: rotor fabrication, alternating magnetic field losses in superconductors, magnetic field configuration required for levitation, damping of rotor oscillation, refrigeration, spinup, and readout. (auth)

27069 (NASA-TN-D-3954) EFFECT OF MECHANICAL VIBRATIONS ON THE PERFORMANCE OF SUPERCONDUCTING MAGNETS. Sarafi, Zoltan W.; Meyn, Erwin H. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). May 1967. 12p. CFSTI.

An experimental investigation was made to determine the effects of a vibration environment on the critical currents of superconducting magnets and to determine a method of obtaining reliable performance of the magnets when subjected to vibrations. The degradation of the critical currents of the magnets was investigated within a vibration range of 100 to 2000 hertz with magnet accelerations up to 440 g. Results are presented showing the dependence of the critical currents and the performance reliability on vibration for potted and unpotted magnets wound of seven-strand and single-strand niobium zirconium (NbZr) cable coils. Simple stiffening of the coils with a potting resin increased the critical current and performance reliability over that obtained from the unpotted magnet subjected to the same vibrations. (auth)

27070 (AD-648885) SUPERCONDUCTING ELECTROMAGNET OF Nb_3Sn. Kuan, Wei-yen; Liu, Ti-han; Cheng, Guo-kuang. Translated from Wu Li Hsueh Pao, 21: 1345-54(1965). 26p. (FTD-HT-66-509). CFSTI.

The results of a study on tubular Nb_3Sn magnets are presented. Magnetic flux jumps were observed. The "frozen" field distribution is closely related to the external field distribution and previous history. The distribution need not be symmetrical with respect to the mid-plane perpendicular to the cylindrical axis, as in the case of soft superconductors. This confirms the suggestion that the sintered Nb_3Sn material is not a homogenous medium. A new magnet structure is described in which magnetic flux jumps can be avoided. Besides using an iron core to trap the magnetic flux, these magnets also have special features in both the excitation and the measurement of magnetic fields. The highest magnetic field obtained in Nb_3Sn magnets was 28.5 kG at 1.5°K. (auth)

27071 (ANL-Trans-455) EXCITATION OF FIRST AND SECOND SOUNDS IN ^3He-^4He SOLUTIONS. Rudavskii, E. Ya.; Serbin, I. A. Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from Zh. Eksp. Teor. Fiz., 51: 1930-3(1966). 6p. Dep. CFSTI. JCL $1.10 fs, $0.80 mf.

The pressure, temperature, and concentration variation amplitudes are calculated for first and second sound waves in superfluid solutions of helium isotopes. It is shown that a surface with a periodically varying temperature induces simultaneously in the solutions first and second sounds whose intensities may be of the same order of magnitude. (auth)

27072 HIGH-ENERGY STRUCTURE IN THE d^2I/dV^2 VERSUS V CHARACTERISTIC OF METAL-INSULATOR-THALLIUM JUNCTIONS. Clark, T. D. (Mullard Research Labs., Redhill, Eng.). Phys. Lett., 24A: 459-60(Apr. 24, 1967).

High-energy structure has been observed in d^2I/dV^2 vs V measurements of metal/insulator/thallium tunnel junctions. This structure was tentatively identified with vibrational modes of impurity molecules contained in the insulator. (auth)

27073 SUPERCONDUCTING CRITICAL CURRENTS OF V_3Ga WIRES MADE BY A NEW DIFFUSION PROCESS. Tachikawa, Kyoji; Tanaka, Yoshiaki (National Research Inst. for Metals, Tokyo). Jap. J. Appl. Phys., 6: 782(June 1967).

A stepwise diffusion process for making V_3Ga wires and the effects of the heat treatment on the superconducting transition temperatures of the V_3Ga wires have been reported earlier. The addition of a Cu coating on the Ga-rich compound phases was found to greatly enhance the formation of V_3Ga. Results of this work are presented. (M.O.W.)

27074 INTRINSIC MAGNETIC FLUX IN A SUPERCONDUCTING SOLENOID. Sychev, V. V.; Zenkevich, V. B.; Andrianov,

V. V. Dokl. Akad. Nauk SSSR, 169: 569-72(July 21, 1966). (In Russian).

A new method is proposed for studying the magnetic properties of a superconducting solenoid in view of the incomplete and contradictory picture of the behavior of a solenoid in a self-field. The magnetic history of the solenoid may be described by using the concept of the total magnetic flux (magnetic linkage) of the solenoid Ψ. This quantity is the sum of the intrinsic Ψ_i and extrinsic Ψ_e fluxes of the solenoid. In an infinite solenoid the extrinsic flux is independent of the intensity of magnetization in the coil and is linearly dependent on the current I flowing in the coil, $\Psi_e = L_eI$, where L_e is a proportionality factor which may be called the extrinsic inductance of the solenoid. It is found that the factor L_e for a solenoid of finite length may be selected so that only the change in extrinsic flux Ψ_e must be considered when the distribution of magnetic induction within the superconductive material is constant. The proportionality factor L_e is taken as $(d\Psi/dI)_{I=0}$ for a solenoid without a magnetic history. Thus for the case where the coil is completely diamagnetic and there is clearly no magnetic flux within the material, $d\Psi/dI = d\Psi_e/\Psi dI$ and $d\Psi_i/dI = 0$, i.e., the change in magnetic linkage is due to the change in the extrinsic flux. Three experimental solenoids are used for studying the magnetic behavior of a solenoid in terms of the intrinsic magnetic linkage. The solenoids were made from 65BT wire, a multicomponent alloy based on niobium and titanium. The wire diameter was 0.25 mm with a stabilizing copper coating and polyester insulation. The results are given on curves showing Ψ_i as a function of I. (ATD)

27075 SOME FEATURES OF THE JOSEPHSON RADIATION. **Ivanchenko, Yu. M. (Donetsk Physical-Technical Inst., USSR). Zh. Eksp. Teor. Fiz., 52: 1320-5(May 1967). (In Russian).**

Broadening of lines emitted from a tunnel superconducting structure is considered. The analysis is carried out under the assumption that the electrons interact with the electromagnetic field in a quantum fashion. It is shown that the amplitude and frequency of the Josephson alternating current cannot be prescribed simultaneously. The dependence of the amplitude on spectrum width of the emitted frequencies is estimated. (auth)

27076 THERMODYNAMICALLY EQUIVALENT HAMILTONIAN METHOD IN NONEQUILIBRIUM STATISTICAL MECHANICS. **Girardeau, M. D. (Univ. of Oregon, Eugene). J. Math. Phys. (N. Y.), 8: 389-99(Mar. 1967).**

The equilibrium statistical mechanics of the Bardeen–Cooper–Schrieffer model of superconductivity, as well as that of a wide class of similar models, can be evaluated exactly by the "thermodynamically equivalent Hamiltonian" method of Bogoliubov, Zubarev, Tserkovnikov, and Wentzel. It has been pointed out by Wentzel that this method can be extended to certain weakly nonequilibrium situations. It is shown here that the method allows an exact evaluation of the nonequilibrium statistical mechanics of the following situations: (a) temporal evolution of the statistical expectation value of an observable O(r) whose initial deviation from equilibrium is spatially localized, but not necessarily small; (b) temporal evolution of the statistical expectation value of an observable O due to a perturbation V which is spatially localized, but not necessarily small. (auth)

27077 ORIGIN OF THE VORTEX FLOW IN HOLLOW CYLINDERS OF TYPE-II SUPERCONDUCTOR. Takacs, S. (Electrochemical Inst., Bratislava). Z. Phys., 199: 495-505(1967). (In German).

The so-called input field intensity H_s arising in the normal vortex in a superconducting hollow cylinder is described. The results were compared with those obtained earlier and an explanation of the deviations is given. (tr-auth)

27078 SUPERCONDUCTING PROPERTIES OF EUTECTICS. **Livingston, J. D. (General Electric Co., Schenectady, N. Y.). J. Appl. Phys., 38: 2408-10(Apr. 1967).**

Results of other investigations on superconducting properties of binary eutectic alloys, particularly the results of Levy, Kim, and Kraft [J. Appl. Phys., 37: 3659(1966)], are discussed. The interference of hysteresis in the distinction between type-I and type-II superconductors on the basis of reversible magnetic behavior is considered. It is pointed out that the critical field of a eutectic alloy is usually controlled by the critical field of the dominant superconducting phase. Where appropriate single-phase data are available, the eutectic critical field can therefore be used as a rough measure of the solute content and superconducting type of the dominant superconducting phase. It is also shown that the eutectic critical field can be very sensitive to specimen history, and that this may explain several discrepancies in the literature. (A.G.W.)

27079 NEW PHASE TRANSFORMATION IN InSb AT HIGH PRESSURE AND HIGH TEMPERATURE. Banus, M. D. (Massachusetts Inst. of Tech., Lexington); Lavine, Mary C. J. Appl. Phys., 38: 2042-6(Apr. 1967).

A new phase transformation at high pressure and elevated temperature has been found in the InSb pressure–temperature phase diagram. This transformation to a new phase designated as InSb III has been established by measurements of superconducting transition temperature (T_c) as a function of annealing temperature at several pressures and by x-ray determinations on the new phase, both retained at one atmosphere and at high pressure and temperature. The higher T_c for InSb III ($T_c = 4.1° \pm 0.1°K$) and the x-ray results lead to the conclusion that InSb III is a new phase different from the orthorhombic phase ($T_c = 3.5°K$). (auth)

27080 SUPERCONDUCTING H_c–J_c AND T_c MEASUREMENTS IN THE Nb–Ti–N, Nb–Hf–N, AND Nb–V–N TERNARY SYSTEMS. Yen, C. M.; Toth, L. E.; Shy, Y. M.; Anderson, D. E.; Rosner, L. G. (Univ. of Minnesota, Minneapolis). J. Appl. Phys., 38: 2268-71(Apr. 1967).

Superconducting critical fields, current densities and temperatures have been measured as a function of composition in the Nb–Ti–N, Nb–Hf–N, and Nb–V–N ternary systems. In the Nb–Ti–N system the upper critical fields increase sharply and monotonically with increasing NbN concentration to over 130 kOe at about 90 mole % NbN. In the Nb–Hf–N system the highest upper critical-field value observed was 130 kOe for the composition $Nb_{0.92}Hf_{0.08}N$. In the Nb–Hf–N system the T_c increases monotonically with NbN concentration, in the Nb–Ti–N system a maximum in T_c exists at about 65 mole % NbN and in the Nb–V–N system a broad minimum exists between 30 and 50 mole % VN. (auth)

27081 THE SUPERFLUID DENSITY AND THE PATASHINSKII-POKROVSKII THEORY OF LIQUID He NEAR T_λ. Moore, M. A.; Stinchcombe, R. B. (Oxford Univ.). Phys. Lett., 24A: 619-20 (May 22, 1967).

The Patashchinskii-Pokrovskii theory of liquid ^4He near T_λ is shown to lead to a temperature dependence $(T_\lambda - T)^{2/3}$ for the superfluid density, in agreement with experiment. (auth)

27082 CRITICAL INDICES OF THE LAMBDA TRANSITION. **Byckling, E. (Univ. of Minnesota, Minneapolis). Contract AT(11-1)-1569. Phys. Lett., 24A: 610-11(May 22, 1967).**

The Widom–Kadanoff scaling laws are derived assuming that the free energy is an analytic function of temperature and the order parameter except at the transition point. Using this formulation and microscopic theory, we argue for an additional relation for the critical indices of the liquid helium λ transition. (auth)

27083 VORTEX NUCLEATION IN TYPE-II SUPERCONDUCTORS. **Kramer, L. (Univ., Hamburg). Phys. Lett., 24A: 571-2(May 22, 1967).**

A thermodynamical instability of type-II superconductors with large κ, occurring at an applied field $H_{s1} = 0.75\ H_c$ is calculated. Vortex nucleation can be delayed for all κ up to higher fields $H_{s2} \geq H_c$. For $\kappa \gg 1$, $H_{s2} = H_c$, in agreement with experiment. (auth)

27084 SUPERCONDUCTIVITY OF HEXAGONAL BERYLLIUM. **Falge, R. L. Jr. (Naval Research Lab., Washington, D. C.). Phys. Lett., 24A: 579-80(May 22, 1967).**

A pure beryllium sample has been found to exhibit bulk superconductivity. The zero field transition is 0.026°K and the magnetically determined coefficient of the electronic term in the specific heat is in accord with that found calorimetrically. (auth)

27085 DIRECT OBSERVATION OF THE LANDAU STRUCTURE OF THE INTERMEDIATE STATE IN SUPERCONDUCTIVE LEAD. **Sarma, N. V.; Moon, J. R. (International Research and Development Co., Ltd., Newcastle-upon-Tyne, Eng.). Phys. Lett., 24A: 580-1(May 22, 1967).**

The laminar structure predicted by Landau for the intermediate state of type-I superconductors has been observed experimentally in polycrystalline lead at 4.2°K. (auth)

27086 MECHANISM FOR INCREASING THE SUPERCONDUCTING TRANSITION TEMPERATURE. **Cohen, M. L.; Koonce, C. S.; Au-Yang, M. Y. (Univ. of California, Berkeley). Phys. Lett., 24A: 582-3(May 22, 1967).**

A mechanism for increasing the superconducting transition temperature is discussed. A few physical examples which involve this mechanism are given. (auth)

27087 ULTRASONIC ATTENUATION IN LEAD: INTERMEDIATE STATE STRUCTURE EFFECTS. **Gottlieb, M.; Jones, C. K.; Garbuny, M. (Westinghouse Research Labs., Pittsburgh). Phys. Lett., 24A: 585-6(May 22, 1967).**

A contribution to the ultrasonic attenuation in the intermediate state of superconducting lead in excess of the ordinary electron attenuation has been measured, analyzed, and compared with theory. (auth)

27088 SURFACE FLUX TRAPPING IN SUPERCONDUCTING Nb. **Flippen, R. B. (E. I. du Pont de Nemours and Co., Wilmington, Del.). Phys. Lett., 24A: 588-9(May 22, 1967).**

Changes observed in the magnetic behavior of superconducting Nb due to surface treatment are attributed to flux trapping at surface defects. (auth)

27089 COMMENT ON THE "EFFECT OF STRAIN AND IMPURITIES ON THE ULTRASONIC ATTENUATION IN SUPERCONDUCTING TIN." Claiborne, L. T.; Einspruch, N. G. (Texas Instruments Inc., Dallas). Phys. Lett., 24A: 589-90 (May 22, 1967).

This letter comments on recent studies by Chaudhuri and Jain (Phys. Letters, 24A: 84(1967)) of deviations from BCS behavior in the temperature dependence of the compressional wave ultrasonic attenuation in Sn at low frequencies (~10 MHz). Evidence is given that the deviations from the expected temperature dependence are due to the total defect structure in the crystal and not due to point defects alone or to large changes in energy gap as was suggested. (auth)

27090 SUPERCONDUCTIVITY IN HEXAGONAL TUNGSTEN BRONZES. **Remeika, J. P.; Geballe, T. H.; Matthias, B. T.; Cooper, A. S.; Hull, G. W.; Kelly, E. M. (Bell Telephone Labs., Murray Hill, N. J.). Phys. Lett., 24A: 565-6(May 22, 1967).**

It is possible, by etching in various acids, to remove alkali-metal ions from hexagonal phase alkali tungsten bronzes, to change their lattice constants and to increase their superconducting transition temperatures substantially. (auth)

27091 ON THE MATHEMATICAL STRUCTURE OF THE B.C.S.-MODEL. **Thirring, W.; Wehrl, A. (Univ., Vienna). Commun. Math. Phys., 4: 303-14(Apr. 10, 1967).**

It is investigated in which sense the Bogolyubov–Haag treatment of the B.C.S. model gives the correct solution in the limit of infinite volume. It is found that in a certain subspace of the infinite tensor product space the field operators show the correct time behavior in the sense of strong convergence. (auth)

27092 SUPERCONDUCTIVITY AT 20°K. **Matthias, B. T. (Bell Telephone Labs., Murray Hill, N. J. Univ. of California, La Jolla); Geballe, T. H.; Longinotti, L. D.; Corenzwit, E.; Hull, G. W.; Willens, R. H.; Maita, J. P. Science, 156: 645-6 (May 5, 1967).**

An increase of superconducting transition temperature to 20.05°K was accomplished through the formation of a solid solution between Nb_3Al and Nb_3Ge, crystallizing in the $\beta-\omega$ structure. A composition of approximately 0.4 Nb_3Al to 1 Nb_3Ge was found. The specific heat versus temperature is shown. (W.D.M.)

27093 QUANTUM LIMIT GALVANOMAGNETIC PHENOMENA IN n-InSb. **Beckman, O.; Hanamura, E.; Neuringer, L. J. (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. Lett., 18: 773-5(May 8, 1967).**

The binding energy of magnetically induced bound states was measured in n-InSb subjected to intense magnetic fields and found to be in agreement with theoretical predictions. Observations of quantum-limit scattering and impurity conduction are discussed. (auth)

27094 THERMODYNAMIC THEORY OF SINGULARITIES OF λ-PHASE TRANSITIONS AND ITS APPLICATION TO LIQUID ^{4}He. Donth, E. Phys. Lett., 24A: 553-4(May 8, 1967). (In German).

Using a general thermodynamic theory for the λ-phase transitions in analogy to the ordinary critical point the following exponents of the temperature dependence below the λ point of liquid ^{4}He are derived: superfluid density $2/3$, density and latent heat of vaporization $1/3$, and specific heat $-2/3$ with a small constant of proportionality. (auth)

27095 THE DIRECT OBSERVATION OF INDIVIDUAL FLUX LINES IN TYPE II SUPERCONDUCTORS. **Essmann, U.; Traeuble, H. (Max-Planck-Institut fuer Metallforschung, Stuttgart. Technische Hochschule, Stuttgart). Phys. Lett., 24A: 526-7(May 8, 1967).**

Triangular flux line lattices were observed by electron microscopy in Pb-4 at. % In and in niobium specimens in the remanent state. These lattices contain various kinds of defects. (auth)

27096 DYNAMIC INTERMEDIATE STATE IN SUPERCONDUCTORS. **Van Gurp, G. J. (Philips Research Labs., Eindhoven, Netherlands). Phys. Lett., 24A: 528-30(May 8, 1967).**

Measurements of the frequency spectrum of the noise voltage across an In-2% Pb foil show that only at low fields and currents is the dc voltage in the current-carrying intermediate state caused by flux motion, in agreement with microscopic observations. (auth)

27097 DETERMINATION OF THE CRITICAL TEMPERATURE OF ANISOTROPIC SUPERCONDUCTORS. **Palistrant, M. E.; Dedju, V. I. (Inst. of Mathematics, Kishinev, USSR). Phys. Lett., 24A: 537-8(May 8, 1967).**

The influence of impurities on the critical temperature (T_c) of a two-band superconductor was investigated, by taking into account the dependence of the electron–electron interaction matrix elements on the momentum directions of the paired particles. (auth)

27098 SUPERHEATING IN PURE SUPERCONDUCTING NIOBIUM. **Renard, J. C.; Rocher, Y. A. Phys. Lett., 24A: 509-11(May 8, 1967).**

Experimental evidence of superheating in pure niobium is presented. Results are in agreement with a superheating field larger than H_c. (auth)

27099 NUCLEAR COOLING APPLIED TO MEASUREMENTS IN ^{3}He. **Osgood, E. B.; Goodkind, J. M. (Univ. of California, San Diego, La Jolla). Phys. Rev. Lett., 18: 894-6(May 22, 1967).**

An apparatus for the use of nuclear adiabatic demagnetization has now produced and maintained submillidegree temperatures for as long as seven hours. It has cooled 0.45 cm^3 of ^{3}He at various pressures to 4 m°K in the liquid state and to approximately 7 m°K in the solid state. Measurements of the nuclear-spin susceptibility, specific heat, and thermal-boundary impedance have been made to these temperatures in the liquid and some preliminary observations made in the solid. (auth)

27100 HIGH-FREQUENCY EFFECTS IN THE ACOUSTIC ATTENUATION OF SUPERCONDUCTING ALUMINUM. **Fagen, E. A.; Garfunkel, M. P. (Univ. of Pittsburgh). Phys. Rev. Lett., 18: 897-9(May 22, 1967).**

Measurements were made of the attenuation of longitudinal acoustic waves in superconducting aluminum at 9.3 GHz. The results exhibit a discontinuity in the attenuation slightly below the transition temperature. (M.O.W.)

27101 MEISSNER EFFECT FOR SUPERCONDUCTORS WITH MAGNETIC IMPURITIES. **Decker, W. R.; Peterson, D. T.; Finnemore, D. K. (Ames Lab., Iowa). Contract W-7405-eng-82. Phys. Rev. Lett., 18: 899-901(May 22, 1967). (IS-1569).**

Th–Gd alloys show a full Meissner effect and magnetization curves which are reversible to 0.6% of H_c. Critical field curves agree with the Abrikosov–Gor'kov theory to an accuracy of about 3%. (auth)

27102 CRITICAL MAGNETIC FIELDS OF GRANULAR SUPERCONDUCTORS. **Abeles, B.; Cohen, Roger W.; Stowell, W. R. (RCA Labs., Princeton, N. J.). Phys. Rev. Lett., 18: 902-5(May 22, 1967).**

Measurements were made of the perpendicular critical magnetic fields of superconducting Al, Sn, and Ga films consisting of small grains. The extremely small grain size (~40 Å) gives rise to perpendicular critical fields up to two orders of magnitude larger than the thermodynamic critical fields. The results indicate that the grains are strongly coupled to each other, and that the enhancement in T_c is independent of the coupling over a wide range of coupling strength. (M.O.W.)

27103 DISPERSION IN SECOND SOUND AND ANOMALOUS HEAT CONDUCTION AT THE LAMBDA POINT OF LIQUID HELIUM. **Ferrell, R. A.; Menyhard, N.; Schmidt, H.; Schwabl, F.; Szepfalusy, P. (Univ. of Virginia, Charlottesville). Phys. Rev. Lett., 18: 891-4(May 22, 1967).**

The absence of a characteristic length at the lambda temperature T_λ of liquid helium is used to determine the wave-number dependence of the phase fluctuations and the second-sound dispersion relation $\omega = ak^{3/2}$ where ω and k are the frequency and wave number and $a \approx 0.1\ cm^{3/2}\ sec^{-1}$. Further predictions are $|T - T_\lambda|^{-1/3}$ singular temperature variation for second-sound damping ($T < T_\lambda$) and the thermal conductivity ($T > T_\lambda$). (auth)

27104 NOISE ASSOCIATED WITH HEAT TRANSFER TO LIQUID HELIUM II. Bussieres, P.; Leonard, A. C. (Royal Military Coll. of Canada, Kingston, Ont.). Cryog. Eng. News, 2: No. 5, 32-4; 36; 38; 40(May 1967).

The existence of two distinct heat transfer mechanisms in liquid He(II) at high temperature differences was demonstrated. In addition to the "steady" film boiling regime, a second heat transfer mechanism exists. This second mechanism is accompanied by a noise similar to that produced by nucleate boiling of conventional liquids and the rapid formation and collapse of relatively large and irregularly-shaped disturbed areas which, when photographed, appear to be bubbles. The conditions required to initiate this mechanism are associated with the jump from convection to the film regime. The conditions are qualitatively evaluated. (W.D.M.)

27105 METHOD FOR INCREASING THE CRITICAL CURRENT DENSITY OF HARD SUPERCONDUCTING ALLOYS AND THE IMPROVED PRODUCTS THEREOF. (to United States

Atomic Energy Commission). British Patent 1,069,258. May 17, 1967. Priority date Aug. 27, 1962, United States.

A method is described for increasing the critical current density of a hard superconducting alloy formed from a metal selected from Groups IVa, Va, and VIa with an element selected from Groups III to VIII. A hard superconducting alloy system whose equilibrium phase diagram displays a multiphase region below a substantially homogeneous solid phase is mixed in the liquid state with an additive selected from the group oxygen, carbon, nitrogen, and hydrogen. The resultant mixture is homogenized at a temperature within the homogeneous solid phase region of the original alloy system to erase compositional variations. The homogenized mixture is heat-treated within a multiphase region displayed by the phase diagram for a period of time sufficient to produce precipitation of a secondary phase. The heat-treated alloy is cooled in order to retain this secondary phase. (M.H.R.)

Plasma and Thermonuclear Physics

27106 (CONF-660452-1) DISPERSIONS- UND STRAHLUNGSEIGENSCHAFTEN VON PLASMEN. (Dispersion and Radiation Characteristics of Plasma). Mollwo, L. (Deutsche Akademie der Wissenschaften zu Berlin (East Germany). Heinrich-Hertz-Institut fuer Schwingungsforschung, Berlin (East Germany)). [1965]. 130p. (In German). Dep. mn.

From Principal Annual Meeting of the DDR Physical Society, Leipzig, Germany.

The nine papers from the Heinrich-Hertz Institut fuer Schwingungsforschung delivered at the annual meeting of the DDR physics society are compiled. The topics include some aspects of wave broadening in plasma, waves in magnetoplasma, Landau damping in anisotropic plasma, kinetic theory and Dawson model, wave propagation in quasi-static approximation perpendicular to the magnetic field, kinetic treatment of the Alfven wave instability, microwave diagnosis of classical gas discharge, microwave radiation from plasmas with low degree of ionization, the dielectric and hydrodynamic theory of the Tonks-Dattner resonances at plasma cylinders, and microwave emission and impedance in the vicinity of Tonks-Dattner resonances. (J.S.R.)

27107 (TID-23760) QUARTERLY PROGRESS REPORT NO. 84. Zimmermann, H. J.; Harvey, G. G. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics). Jan. 15, 1967. Contract AT(30-1)-3581. 400p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Separate abstracts were prepared for 8 of the included sections. (M.O.W.)

For abstracts of individual sections see: 26935, 26936, 26974, 27055, 27115, 27131, 27147, and 27148.

27108 (NASA-TT-F-449) HIGH FREQUENCY PROPERTIES OF PLASMA. Sinel'nikov, K. D. (ed.). Translation of Vysokochastotnyye Svoystva Plazmy, Academy of Sciences, Kiev, 1965. 214p. CFSTI $3.00 cy, $0.65 mn.

The lead abstract for this book in original Russian appeared previously in Vol. 21, No. 9 of NSA, Abstract No. 15085. Separate abstracts appear in that issue for 23 of the papers. (M.O.W.)

27109 SPECTROSCOPIC INVESTIGATIONS ON ELECTRIC DISCHARGES IN BEAMS OF CONDENSED HYDROGEN. Klingelhoefer, R.; Roehl, H.; Wuest, J. (Technische Hochschule, Karlsruhe, Ger. Kernforschungszentrums, Karlsruhe, Ger.). Z. Naturforsch., 21a: 1967-70(Nov. 1966). (In German).

The emission spectrum of a plasma produced with H_2 cluster beams was investigated along the beam direction. At an electrodistance of 26 cm in a region of 14 cm, only the emission of H_2 was observed and it also occurs in the vicinity of the electrode lines of the electrode material. (tr-auth)

27110 MAGNETO-FLUID AND PLASMA DYNAMICS. Grad, Harold (ed.). Proceedings of Symposia in Applied Mathematics held in New York April 13-14, 1965. Volume XVIII. Providence, American Mathematical Society, 1967. 298p. $6.80. (CONF-650440).

Fourteen papers are included which treat physical and mathematical aspects of the interaction between electromagnetic fields and fluids. Topics covered include: hydromagnetic shock waves, plasma shock structures, stability of slightly resistive plasma, aligned magnetic field, hydromagnetic instability of sub-Alfven equations, singular eigenfunctions in plasma problems, quasilinear theory of plasma waves, longitudinal plasma oscillations, exchange invariance in fluid systems, guiding center plasma, plasma microinstability, plasma kinetic theory, quasi-particles in plasma, and Ohm's law from instability. (D.L.C.)

Confinement and Heating of Plasma

Refer also to abstracts 27141 and 27261.

27111 (EUR-3288.e) COMPUTATION OF THE COMPRESSION OF A MAGNETIC FIELD BY MEANS OF A LINER DRIVEN BY AN EXPLOSION. Guerri, L.; Stella, P.; Taroni, A. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Apr. 1967. 32p. Dep.

The numerical solution of the following problem is described. A cylindrical liner, surrounded by an explosive ring, bounds a magnetic field. This field exerts a pressure on the internal wall of the liner, while the diffusion of the field on the interior of the liner is neglected. A detonation front, started on the external side of the explosive ring, reaches the liner and pushes it concentrically towards the axis. First the propagation of the detonation front and the state of the gas behind it is computed. Afterwards the interaction liner gas is treated. The computation is carried out under the hypothesis of axial symmetry. (auth)

27112 (MATT-530) THE LIVERMORE ℓ = 2 STELLARATOR. Sheffield, George V.; Johnson, John L. (Princeton Univ., N. J. Plasma Physics Lab.). Feb. 1967. Contract AT(30-1)-1238. 12p. Dep. CFSTI.

A high-shear l = 2 stellarator with a 9" major radius, 3" minor radius, and five field periods is being constructed at Livermore to study the confinement of Cs, K, or Li. Some of the magnetic properties of this stellarator are described. (M.O.W.)

27113 (MPI-PAE/P1-4/65) VORLAEUFIGE ERGEBNISSE UEBER DAS VERHALTEN EINES PLASMAS MIT HOHEM BETA IN TOROIDALEN MAGNETFELD MIT UEBERLAGERTEM MULTIPOLFELD. (Preliminary Results on the Behavior of a High-Beta Plasma in a Toroidal Magnetic Field with Superimposed Multipole Field). Gierke, G. v.; Lotz, W.; Rau, F.; Remy, E.; Wolf, G. H. (Max-Planck-Institut fuer Physik und Astrophysik, Munich (West Germany)). Apr. 1965. 15p. Dep.

Superimposing the magnetic field of a system of Ioffe-bars over the purely azimuthal main field of a toroidal theta pinch coil, an equilibrium high-beta plasma configuration is obtained, though without closure. In the parameter range of $T_e \approx 10$ eV and $n_e \approx 10^{16}$ particles/cm^3 it was observed by means of smear camera pictures that the confinement time of a toroidal plasma ($R = 26$ cm, $r \approx 1$ cm) can be considerably prolonged by additional multipole fields. The best results were obtained with a hexapole configuration. The determination of the prolongation factor of the confinement time requires an exact measurement of the plasma loss rate; such measurements are in progress. From the temporal behavior of the emission of visible light one can estimate a prolongation factor of about 5 to 10. Using an M-and-S-like toroidal main field instead of the purely azimuthal field, no further improvement of the plasma confinement was observed. (auth)

27114 (TID-13705) REPORT OF AD HOC PANEL ON SCYLLAC. (Ad Hoc Panel on Scyllac). July 1966. 74p. Dep. CFSTI.

This panel was convened by the AEC to provide a technical evaluation of the proposal to build a large, new theta-pinch facility (Scyllac) at LASL. A summary of the views of the panel is given on the following: (a) scientific goals, specific approaches, and relative importance, (b) theoretical considerations, (c) scale and energy considerations, (d) engineering problems and solutions, and (e) time, manpower, and cost estimates. (M.O.W.)

27115 (TID-23760, pp 175-9) INTERACTION OF LASER RADIATION WITH PLASMAS AND NONADIABATIC MOTION OF PARTICLES IN MAGNETIC FIELDS. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics).

A brief discussion is presented on the nonadiabatic trapping of an injected electron beam in a toroidal magnetic field. (M.O.W.)

27116 (UCID-15105) CONSTRUCTION AND OPERATION OF A FAST ION GAUGE IN THE 2X MACHINE. Ellis, Robert E. (California Univ., Livermore. Lawrence Radiation Lab.). Mar. 5, 1967. Contract W-7405-eng-48. 15p. Dep. CFSTI.

A fast ion gage has been constructed and used to determine the neutral pressure during the formation and decay of a plasma in the 2X machine. The gage has been operated in a magnetic field of 2000 gauss and appears to be quite rugged and reliable. Some preliminary results of measurements in the gettered (with titanium vapor) and ungettered 2X system are given. (auth)

27117 (UCRL-50187) CHERENKOV TRAPPING OF CURRENT LOOPS IN A PLASMA. Bodner, Stephen E. (California Univ., Livermore. Lawrence Radiation Lab.). Feb. 21, 1967. Contract W-7405-eng-48. 17p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Previous analyses of Astron trapping phenomenon have not considered the interaction of the moving current distribution with the plasma background. For example, the magnetic field associated with a current distribution has been taken as if current were located in free space, rather than in a dielectric medium that transmits the gross magnetic field properties at the Alfven speed. It is shown that for one simple idealized case the interaction with the background plasma is very strong, producing significant radiation. This interaction may be usable as a trapping mechanism for electron or ion current loops in a plasma. (auth)

27118 (LA-tr-65-30) INTERACTION OF PLASMA BLOBS WITH MAGNETIC FIELDS. Voitsenya, V. S.; Gorbaniuk, A. G.; Zykov, V. G.; (and others). (Akademiya Nauk Ukrainskoi SSR, Kharkov. Fiziko-Tekhnicheskii Institut). Translated by Helen J. Dahlby (Los Alamos Scientific Lab., N. Mex.), from Paper Presented at the Second International Conference on Plasma Physics and Controlled Nuclear Fusion Research, Culham, England, September 6–10, 1965. 15p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. JCL $1.60 fs, $0 mf.

The problem of the passage of a plasma through a toroidal solenoid and the related effect of purification of plasma from impurities of heavy ions were studied. (M.H.R.)

27119 (UCRL-Trans-1262) AN INJECTOR OF FAST HYDROGEN ATOMS. Artemenkov, L. I.; Klochkov, N. I.; Kuznetzov, V. V.; Kulygin, V. M.; Malakhov, N. P.; Mukhin, P. A.; Panov, D. A.; Svishchev, V. S.; Semashko, N. N. Translated by R. V. Pyle (Univ. of California Lawrence Radiation Lab., Berkeley), from Paper Presented at the 7th International Conference on Ionization Phenomena in Gases, Belgrade, August 20–31, 1965. 21p. Dep. CFSTI. JCL $2.60 fs, $0.83 mf.

A beam of fast hydrogen atoms is formed by charge exchange or dissociation of an ion beam in a gas target. The proton component of the current, extracted from the ion source across a magnetic field and focused by the magneto-optical system of the injector, exceeds 2A for energies of 100 to 15 keV, and the molecular component reaches 0.7A. Fluctuations in the plasma of the arc-discharge source and modulation of the accelerated ion beam were investigated. Questions connected with the high-voltage resistance of the source during formation of strong beams, and the source of parasitic electron currents were investigated. A defined ion beam passed through supersonic streams of CO_2 gas and Mg vapor. The number of fast atoms with energies of 80 to 100 keV, obtained as a result of charge exchange in the CO_2 jet, is about 20% of the number of protons entering the neutralization chamber, and is about 30% for dissociation of molecular ions in the Mg jet. (M.O.W.)

27120 (UCRL-Trans-1282(L)) INJECTION OF PLASMOIDS INTO A MIRROR TRAP WITH ADIABATIC PLASMA COMPRESSION ("ASPA" APPARATUS). Karchevskii, A. I.; Babichev, A. P.; Muromkin, Yu. A.; Buryak, E. M.; Gorbunova, E. F. Translated for Univ. of California Lawrence Radiation Lab., Livermore, from Paper CN-21/162 Presented at the Conference on Plasma Physics and Controlled Nuclear Fusion Research, Culham, England, September 6–10, 1965. 35p. CFSTI. JCL $3.60 fs, $1.25 mf. Dep.

An account is given of the main characteristics of the Aspa machine, built for study of adiabatic compression of plasma in traps with a mirror-configuration magnetic field. The vacuum chamber is placed in a solenoid (4 meters long, 1 meter in diameter) along whose axis a quasi-stationary longitudinal guiding magnetic field (of strengths up to 5 kOe) can be created. A titanium injector or coaxial plasma gun is used as the deuterium-plasma source. A plasmoid is injected along the machine's axis and enters the working compressing region, a glass tube 10 cm in diameter. The pulsed mirror-configuration magnetic field is produced by two coils 20 cm apart (mirror ratio 1 : 2). The field's maximum strength in the mirrors is 40 kOe, its rise time 40 μsec and decay time 350 μsec. A mass-spectrometer study was made of the composition and energy distribution of the ion component of plasma in titanium and coaxial injectors. The density of a plasmoid traveling from the injector to the working compression region is measured with a microwave interferometer. Investigated too is the passage of a plasmoid through a magnetic mirror with field strength up to 20 kOe. In some experiments the mirror field parallels the guiding magnetic field, in others is antiparallel, i.e., a field of the diverter type with two regions of zero field strength is created. It is shown that (with both the titanium and coaxial injector) an injected plasmoid penetrates the magnetic mirror with relative ease when the mirror-field's direction coincides with that of the guiding field, but virtually does not penetrate in the case of the diverter-type field. On the basis of these experiments the possibility is demonstrated of cutting off the injected plasma's heavy components with a pulsed magnetic shutter that creates regions in which the field strength is zero and the magnetic lines of force escape to the chamber walls. In preliminary experiments on adiabatic compression of plasma in mirror-configuration traps hard x rays are recorded (energy 30 keV). The influence of the initial magnetic field and plasmoid parameters on the intensity and hardness of this radiation is studied. (auth)

27121 TURBULENT HEATING OF IONS IN A CURRENT OF NONISOTHERMAL PLASMA. Kovrizhnykh, L. M. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz., 52: 1406-21 (May 1967). (In Russian).

Equations are derived and analyzed which describe the behavior of the electron and ion distribution functions and the energy spectral density of plasma noise. The deduction is based on the solution of the nonlinear problem of instability of a nonisothermal plasma located in an external electric field. It is shown that in a quasistationary regime restriction of growth of ion–acoustic oscillations is accompanied by a sharp increase of the plasma resistance and by heating of the electron as well as of the ion components of the plasma. The most effective is heating of resonance ions for which the effective temperature grows appreciably faster than the electron temperature and in a number of cases may considerably exceed the latter. Under certain conditions (sufficiently strong electric fields) the process is accompanied by the appearance of high-energy runaway electrons and ions. (auth)

27122 EXPERIMENTS ON JOULE HEATING OF SHOCK-IONIZED AIR. **Selamoglu, Suha (Brown Univ., Providence). Contract AF49(638)-1295. AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 5: 847-52(May 1967).**

The heating of ionized air by means of low-voltage dc discharge between cold, plane electrodes is controlled primarily by the thermal boundary layers adjacent to the electrodes. In shock-ionized air at 6700 to 7800°K and 10 to 20 atm, three characteristic domains of discharge intensity are estimated experimentally. When the discharge power per unit boundary-layer area is just below 1 kW/cm^2, the thermal boundary-layer thickness is nondecreasing in time. Between 1 and 100 kW/cm^2 the thickness decreases with no significant heating effect in the outer region within a practically short time. Above 100 kW/cm^2 the boundary layer shrinks very rapidly; an immediate heating of the free gas follows. The total Joule heat rate in the outer region becomes comparable with that in the boundary layer only in the strong discharges where the current density is of the order of 10^3 amp/cm^2. (auth)

27123 EQUILIBRIUM AND STABILITY OF A TOROIDAL SCREW PINCH. **Bobeldijk, C.; Rietjens, L. H. Th.; Van der Lann, P. C. T.; De Bats, F. Th. (FOM-Inst. for Plasma-Physics, Jutphaas, Netherlands). Plasma Phys., 9: 13-22(Jan.-Feb. 1967).**

A toroidal plasma column, produced and confined by a rapidly rising helical magnetic field, is studied. This "screw pinch" is of interest because it is in equilibrium and is completely reproducible. The discharge vessel is a quartz torus with major and minor diameters of 72 and 12 cm. (UK)

27124 ELECTRON–CYCLOTRON HEATING IN A MIRROR MACHINE. **Tuma, D. T.; Lichtenberg, A. J. (Univ. of California, Berkeley). Plasma Phys., 9: 87-91(Jan.-Feb. 1967).**

Numerical solutions are presented for the exact equations of motion of a relativistic electron in a magnetic mirror field interacting with an electromagnetic wave travelling along the axis of the mirror. (UK)

27125 PLASMA CONFINEMENT DURING A PERIOD OF REDUCED FLUCTUATIONS IN 'ZETA'. **Gibson, A.; Coxell, H.; Powell, B. A.; Reid, G. W. (Culham Lab., Abingdon, Eng.). Plasma Phys., 9: 1-12(Jan.-Feb. 1967). (CLM-P-105).**

Measurements of electron density and of the intensity of He-II radiation are used to determine the plasma confinement time during a specific period in a helium discharge. It is shown that the confinement time during a period of reduced fluctuations in ZETA is considerably longer than at other times in the pulse. (auth)

27126 LIMITATION ON ION CYCLOTRON HEATING IN THE LOCAL MIRRORS OF THE C STELLARATOR. Iiyoshi, A.; Yamato, H.; Yoshikawa, S. (Princeton Univ., N. J.). Phys. Fluids, 10: 749-55(Apr. 1967). (MATT-411).

The experimental observation of the limiting phenomena of ion cyclotron resonance heating in the shallow magnetic beach is described and its explanation by the reflection of the wave is discussed. The temperature–anisotropic-plasma-dispersion relation is solved with the aid of an electronic computer. The unexpected singular point which causes the reflection of waves is found in the unstable region of the ion cyclotron wave. The calculated limiting value of the ion temperature due to the wave reflection is given by $\beta_{\perp c} \approx 4(T_{||}/T_{\perp})^2$, in reasonable agreement with the experiment. (auth)

27127 CONFINEMENT OF ENERGETIC PLASMA IN MAGNETIC MIRRORS IN THE MODEL C STELLARATOR. Yamato, H.; Iiyoshi, A.; Rothman, M. A.; Sinclair, R. M.; Yoshikawa, S. (Princeton Univ., N. J.). Phys. Fluids, 10: 756-66(Apr. 1967). (MATT-450).

Ion cyclotron waves are set up in a toroidal plasma (previously formed by Ohmic heating) contained in the Model C stellarator, and absorbed at local minima in the confining magnetic field. The plasma ($10^{12}-10^{13}$ cm^{-3}) confined in these magnetic mirrors under certain conditions has little interaction with the main body of the plasma; the perpendicular ion temperature can reach several keV, while the electrons remain at less than 100 eV. Thus a regime not yet available to other mirror confinement experiments is reached. The observed cooling of the plasma in the mirrors agrees with the calculated ion-ion and ion-electron loss processes and charge exchange. At the highest temperatures and lowest densities, the confinement time in the mirrors is limited to ~1 msec, most likely by charge exchange with a steady influx of neutral hydrogen. No evidence is found for any anomalous particle- or energy-loss process, although several instabilities are predicted by theory to occur. (auth)

Diagnostics of Plasma

Refer also to abstracts 26265, 26289, and 27145.

27128 (ARL-67-0020) DIAGNOSTICS OF MAGNETOPLASMAS BY LARGE ANGLE LASER SCATTERING. Shkarofsky, I. P. (RCA Victor Co., Ltd., Montreal (Quebec). Research Labs.). Jan. 1967. Contract AF33(615)-2196. 108p. CFSTI.

A review of experiments on laser scattering from plasmas is given which indicates that any static magnetic field if present has not been utilized for diagnostics. The appendix summarizes the theory on scattering of electromagnetic waves from an infinite magnetoplasma with arbitrary velocity distributions for electrons and ions. The equations are then simplified to apply to electrostatic fluctuations. It is shown that one can provide large angle scattering in the plane perpendicular to the magnetic field near certain electrostatic resonances, namely the upper hybrid (when the ratio of plasma to cyclotron frequency is greater than $\sqrt{3}$) and the cyclotron harmonics. The perpendicular wave numbers associated with these magnetoplasma resonances can become large. Also the plasma resonance and upper hybrid resonance at low density are discussed. For densities 10^{12} to 10^{13} cm^{-3}, temperatures 2000 to 3000°K, and using a 10.6μ laser, the electron velocity distribution function is obtainable from the form of Landau damping acting on the plasma resonance, whereas collisional damping is usually stronger than cyclotron damping for the other resonances. Also the damping expression for the upper hybrid at high plasma densities suffers from complexities in analysis. All resonances are useful to yield electron density and temperature from the dispersion effects. Several interesting experiments are suggested. (auth)

27129 (D-1-82-0602) PERTURBATION OF MICROWAVE CAVITIES BY LOSSY DIELECTRICS AND PLASMAS. Hall, Richard B. (Boeing Scientific Research Labs., Seattle, Wash. Plasma Physics Lab.). Feb. 1967. 41p.

The frequency shift and Q change of a microwave cavity caused by lossy dielectrics or plasma spheres or cylinders is calculated. The necessity for this analysis is prompted by the use of microwave cavities to measure the expansion of nearly spherical plasmas created by focused high power lasers. The conditions required for the perturbing volume to behave as if it were a perfect conductor are examined. It is found that much lower conductivities (or permittivities) are required when the perturbing volume is placed in a cavity region where electric energy is predominant. (auth)

27130 (IPP-2/59) UNTERSUCHUNG UEBER DIE AUSBREITUNG VON ELEKTROMAGNETISCHEN WELLEN IN EINEM ZYLINDRISCHEN PLASMA MIT MAGNETFELD. **(Investigation of Electromagnetic Wave Propagation in a Cylindrical Plasma With a Magnetic Field). Weinhardt, K. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Mar. 1967. 62p. (In German). Dep.**

Propagation of S-band (3×10^9 cps) microwave signals parallel to the magnetic field lines in the positive column of an argon hollow-cathode arc discharge has been studied. The applied frequency was less than both the electron gyrofrequency and the electron plasma frequency. Initially the waves were excited and detected by small stub antennas. The observations could not be explained by whistler mode theory of infinite plasmas. This suggested that the boundaries are important. In a second experiment, an attempt was made to excite only circularly symmetric modes. These measurements were compared with dispersion relations for circularly symmetric modes calculated by using the complete Maxwell equations, the ϵ-tensor for a cold collisionless plasma, and suitable boundary conditions. It could be shown that the mode which was excited was most likely determined by the boundary of the coupling system and not by the boundary of the whole vessel as originally expected. (auth)

27131 (TID-23760, pp 123-36) PLASMA PHYSICS. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics).

A discussion is presented of a double-beam optical-null spectrophotometer for measuring the absorption of far infrared radiation ($0.1 < \lambda < 1$ mm) by a plasma in order to determine experimentally the plasma mechanisms responsible for the emission of incoherent far infrared radiation. Dispersion relations were experimentally determined for electron plasma oscillations and a measurement was made of their temporal growth rate. (M.O.W.)

27132 (UCID-15107) SPECTROSCOPIC DIAGNOSTICS OF THE 2X PLASMA. **Kovar, Frederick R. (California Univ., Livermore. Lawrence Radiation Lab.). Mar. 30, 1967. Contract W-7405-eng-48. 30p. Dep. CFSTI.**

Spectroscopic techniques were used to measure several physical quantities of the 2X mirror machine plasma for various machine conditions. Results indicated that improved vacuum obtained through the use of titanium gettering has reduced the background densities of neutral hydrogen and impurity ions and has helped maintain high electron temperatures later in time. Measurements on electron temperature employing the line intensity ratio technique indicated electron temperatures in excess of 100 eV. Under the best vacuum conditions with maximum ion density of about 5×10^{12} ions per cm^3 the neutral hydrogen background density was less than 4×10^9 cm^{-3}. Oxygen impurity ion concentration could not be measured at the lowest injected densities but at higher densities (~2×10^{13} ions per cm^3) it was about 4% of the electron density. (auth)

27133 INEQUILIBRATE CONDUCTIVITY OF ARGON-CESIUM PLASMA. Kasabov, G. A. Teplofiz. Vysok. Temp., 4: 729-30(Sept.-Oct. 1966). (In Russian).

The results of V. S. Golubev et al. (1964) in studies of stationary argon-cesium plasma parameters at 20- to 240-mm Hg pressure showed inequilibrate conductivity of the order of 1 ohm^{-1} cm^{-1} at $E/p \approx 10^{-2}$ V cm^{-1} (mm Hg) and gave the measurements of the gas temperature, conductivity, temperature and concentration of electrons, and other plasma parameters. Analysis of the data indicated that the Coulomb cross sections were too low. The corrected cross section value $(Q_i) = 3.6 \times 10^{-14}\, T_1^{-2} \ln\Lambda$ ($\ln\Lambda = 23.1 - \frac{1}{2} \ln n_1 + \frac{3}{2} \ln T_1$) was used in the analysis of the above data and other published literature data. (R.V.J.)

27134 OPTICAL INVESTIGATIONS ON SPARK DISCHARGES. **Herrmann, Diethard (Univ., Greifswald, Ger.). Beitr. Plasmaphys., 6: 409-15(1966). (In German).**

The emitted radiation and the time displacement to the current were investigated for high-current spark discharges (32,000 amp) as functions of the condenser initial voltage, the capacity, and the pressure. The discharge apparatus had an electrode gap of 11 mm. A condenser battery of 8 to 113 μF, which could be charged with voltages from 0.5 to 3 kV, was used as the energy source. In most cases a special high-current circuit introduced the discharge. An arrangement of multiplier, amplifier, pulse oscillograph, and photocamera recorded the emission discharge. (tr-auth)

27135 MEASUREMENT OF THE PRESSURE BROADENING OF LINES OF THE SECOND LYMAN SERIES OF THE HELIUM ION. **Hessberg, H.; Boetticher, W. (Univ., Kiel). Z. Naturforsch., 22A: 316-21(Mar. 1967). (In German).**

In a pulsed capillary discharge a helium plasma of high electron density ($n_e = 2$ to 4×10^{18} cm^{-3}) and temperature (T = 50000 to 55000°K) was produced. The plasma data were determined from measurement of the line width as well as the intensity ratios line/continuum of the He II line 4686Å. With the help of these data, from the measured profile, the normalized profile of the He II lines lying at $\lambda = 1640$, 1215, and 1085Å in the vacuum ultraviolet was found. Because of the good reproducibility and the high density of the emitted plasma, it is suitable as a light source at 1640Å. (tr-auth)

27136 SHOCK TUBE SIDE-WALL ELECTROSTATIC PROBES. **Liu, J. T. C. (Princeton Univ., N. J.). Contract AF33(615)-3328. AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 5: 891-8 (May 1967).**

Analytical forms for the local electrical characteristics and resistance associated with shock tube side-wall electrostatic probes are derived as functions of distance behind the ionizing shock wave for large electrical Reynolds numbers. The continuum theory of Lam for the flow of weakly ionized gases over biased arbitrary bodies with absorbing surfaces is applied to interpret the available experimental results. For this purpose, the simplifying assumptions of isothermal, incompressible flow with no gas phase reactions are made to obtain the following contributions to the potential drop across electrodes: 1) the outer region, accounting for the electrode geometry and its relative location to the current-insulating shock wave, obtained from Laplace's equation; 2) the ambipolar region, obtained from the ambipolar convective-diffusion equation; and 3) the sheath region, in terms of a universal function. The operating characteristics of the electrode system with an external circuit as in a typical experimental setup are discussed in detail. Qualitative agreement between theory and available experiments is obtained and most of the experimental observations are explained within the present much-simplified physical framework. (auth)

27137 PROBE MEASUREMENTS OF PLASMA RINGS INJECTED INTO AN AXIAL GUIDE FIELD. Small, R. L. (Grumman Aircraft Engineering Corp., Bethpage, N. Y.); Valsamakis, E. A.; Bostick, W. H. AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 5: 853-7(May 1967).

Experimental measurements of the local magnetic field, ion density flow, and electric field have been made in the downstream plasma generated by a theta-pinch accelerator in a uniform guide field. From data obtained with small three-directional probes, certain gross features of the plasma structure, as a function of its downstream position, are inferred. A conically shaped, theta-pinch coil, ringing at approximately 40 kHz with a maximum magnetic field strength of 3.5 T, injects preionized argon into a 0.26-T axial guide field. The geometries of and electronics involved with the probes are discussed. The gross features of the radial and axial magnetic probe data and the biased double-probe (ion density flow) data imply the existence of at least three separate plasma rings. These rings have a unidirectional azimuthal current and move downstream at approximately 10^4 m/sec. Probe data at several downstream points indicate a tendency for these rings to coalesce. (auth)

27138 TEMPERATURE MEASUREMENTS ON A SUBATMOSPHERIC ARGON PLASMA JET. Adcock, B. D. (Imperial Coll. of Science and Tech., London). J. Quant. Spectros. Radiative Transfer, 7: 385-400(May-June 1967).

The excitation temperature in the free stream of a low-pressure (10 Torr) argon plasma jet was measured, using the method of relative spectral line intensities, and it is shown that this property is, in fact, the kinetic temperature of the free electron gas. From this result the kinetic temperature of the heavy particles may be deduced, and it is demonstrated that, whilst local thermodynamic equilibrium exists, the flow may be described by a sudden freezing approximation. This freezing takes place within the nozzle at, or some way downstream of, the sonic throat, from which point on the degree of ionization remains constant. It is verified that the plasma in the settling chamber (0.2 to 0.35 atmosphere) is in equilibrium, and this result is invoked to measure the transition probability ratio of the line pair λ4300 Ar 1 and λ4182 Ar 1. (auth)

27139 EFFECT OF A UNIFORM MAGNETIC FIELD ON THE PROFILES OF HYDROGEN LINES. Nguyen-Hoe; Drawin, H.-W.; Herman, L. (Faculte des Science, Paris). J. Quant. Spectros. Radiative Transfer, 7: 429-74(May-June 1967). (In French).

The profiles of the hydrogen lines were calculated, taking into account the intermolecular electric field, the electronic collisions. and an external homogeneous magnetic field in which the plasma is embedded. Electron densities within the range 10^{15} to 10^{18} cm^{-3} and magnetic field strengths of 1.2×10^5 Γ are considered. These values cover practically all experimental conditions realizable in the present state of plasma physical research. Only the numerical results for the lines, Ly-α, Ly-β and H-α are given. For very small magnetic fields, the calculated line profiles coincide with the pure Stark profiles recently calculated by Griem, Kolb and Shen. With increasing magnetic fields, important deviations appear. The essential parameters for these deviations are, firstly the direction of observation with regard to the direction of the magnetic field, and secondly the ratio between the Zeeman splitting in a magnetic field only and the Stark splitting due to the mean intermolecular electric field. Experimental line profiles were obtained using a linear discharge tube surrounded by an induction coil. The comparison of the theoretical with the experimental profiles shows a satisfactory agreement. The results for the lines originating from higher principal quantum numbers are being investigated. (auth)

27140 ELECTRICAL CONDUCTIVITY OF A PARTIALLY IONIZED GAS IN A MAGNETIC FIELD. Schweitzer, S. (Univ. of Pennsylvania, Philadelphia); Mitchner, M. Phys. Fluids, 10: 799-806(Apr. 1967).

The use of the Lorentzian scalar electrical conductivity as a basis for constructing a mixture rule for partially ionized gases is extended, and mixture rules for the tensor components of the electrical conductivity are proposed. A comparison with the third Chapman–Enskog approximation shows that the proposed mixture rules give conductivity values which are within approximately 15% of the more accurate results. A similar comparison for the mean-free-path formulas (neglecting ion-slip) is less favorable. It is concluded that the proposed conductivity formulas provide a satisfactory method for calculating the tensor conductivity for a wide range of electron–neutral cross sections and magnetic field strengths, and for all degrees of ionization. (auth)

Kinetics of Plasma

Refer also to abstracts 27053, 27131, 27204, and 27211.

27141 (AD-641281) GUIDING CENTER APPROXIMATION IN LOWEST ORDER. Banos, Alfredo Jr. (California Univ., Los Angeles. Plasma Physics Group). Sept. 1966. Contract Nonr-4756(01). 31p. CFSTI $3.00 cy, $0.65 mn.

A simple and direct derivation of the equations governing the motion of a charged particle in space and time dependent electric and magnetic fields in the so-called guiding center approximation is given. Attention is given exclusively to results in lowest order in an expansion in reciprocal powers of the cyclotron frequency. As is well known, results to lowest order are the most frequently employed for practical as well as for didactic reasons. Yet, there appear to be no elementary derivations of these results, which are at once general and comprehensive, but which do not employ the complicated machinery of the formal asymptotic expansions of Bogolyubov and Zubarev and of Kruskal. (TAB)

27142 (D-1-82-0608) GIGAHERTZ RADIATION FROM MAGNETIC-FIELD-FREE ELECTRON-HOLE PLASMAS. Ancker-Johnson, Betsy (Boeing Scientific Research Labs., Seattle, Wash. Plasma Physics Lab.). Mar. 1967. 51p.

It is shown that gigahertz radiation is emitted from electron-hole plasmas in p-InSb at 77°K whose only external influence is an applied voltage. In order to satisfy the conditions for radiation the plasma must have a conductance which falls within a limited range. The appropriate plasma conductances require unusually high average electric field strengths E with attendant low average current densities J. The area of the J–E plane associated with radiation is accessible only with plasmas produced in high quality InSb. More conductance conditions necessary for radiation become accessible by applying a staircase voltage function instead of the usual squarewave because plasma is accumulated from step to step. Some properties of the radiation are described such as its extreme sensitivity to plasma conductance, its decay characteristics, and a possible correlation between radiation amplitude and current level. The radiation is also observed at current levels which are far above its current threshold. With 2 orders of magnitude more plasma current flowing, namely ~2A instead of ~20 mA, radiation occurs during plasma pinching. A further extension of accessible conductance conditions that are suitable for producing radiation, particularly an extension to higher electric field strengths at low current densities, is obtained by application of magnetic field strengths of a few hundred gauss. Many data obtained by fulfilling the necessary condition for radiation, namely the appropriate range of plasma conductance, are summarized. Evidence that this is not a sufficient condition when the plasma conductance is "tuned" by means of a magnetic field is discussed. (auth)

27143 (N-67-16618) INTERACTION BETWEEN ION BEAMS AND PLASMAS. Wong, A. W.; Baker, D.; Sellen, J. M. (California Univ., Los Angeles). Dec. 1, 1966. 14p. (NASA-CR-81340; N-2). CFSTI $3.00 cy, $0.65 mn.

Preliminary results from studies oi the interaction between a low-energy cesium ion beam (1 to 30 eV) and a thermal cesium plasma (.25 eV) are reported. Investigations were made of the stability limits for low-frequency oscillations in the ion beam-plasma system confined by a magnetic field. It was found that the density gradients supported by the magnetic field give rise to an azimuthal component to the unstable wave, thus changing the wave character from that in a homogeneous infinite plasma. Also investigated were the attenuation and the phase velocity of low frequency ion acoustic waves in a stable ion beam-plasma system. (STAR)

27144 (R65SD65) EQUATIONS GOVERNING APPROACH TO EQUILIBRIUM OF A RADIATIONG GAS. I. CYCLOTRON RADIATION. Smith, John M. (General Electric Co., Philadelphia, Pa. Missile and Space Div.). Nov. 1965. 112p.

The kinetic equation for the single particle distribution function and the equation of radiative transport are developed for a fully ionized gas interacting via its transverse or radiation field in the presence of an externally applied magnetic field. The starting point of the analysis is with Liouville's equation for N particles and a denumerably infinite set of oscillators. The dynamical character of the system is described by the Heitler Hamiltonian. The reduction of Liouville's equation to the single particle distribution function and the equation of radiative transport is accomplished by analogy to the perturbation technique used by Prigogine and his coworkers to reduce Liouville's equation for a plasma interacting via its longitudinal or Coulomb field. The equations obtained are to first order in the interaction parameter, which results in Fokker–Planck type equations. (auth)

27145 (SIT–2813-40) ANNUAL PROGRESS REPORT [ON PLASMA PHYSICS]. Rogers, K. C.; Motz, R. O. (Stevens Inst. of Tech., Hoboken, N. J.). Mar. 1967. Contract AT(30-1)-2813. 37p. Dep. CFSTI.

A study was made of the relationship between microinstabilities and cross-field plasma diffusion in low-β, highly ionized magnetoplasmas. This program was outlined in detail in earlier reports. The work consists of two distinct but parallel phases: (a) The study of cross-field plasma diffusion in a single-ended "Q" device in the presence of drift waves and other instabilities — both conventional Langmuir probes and a special gridded probe are used. (b) Studies of the steady-state characteristics of barium "Q" plasmas using optical techniques — these techniques are being developed to study instabilities and their influence on the steady-state characteristics (electron and ion temperatures and densities) of barium "Q" plasmas, both single and double ended. An important by-product of the barium plasma work is the calculation and measurement of the cross sections for electron collisional excitation of the low-lying barium ion states. (auth)

27146 (SUIPR–100) LANDAU WAVES. Simonen, Thomas C. (Stanford Univ., Calif. Stanford Electronics Lab.). Jan. 1967. Contract AF 33(615)-1504. 153p. (ARL–67-0012).

A comprehensive theoretical and experimental study was made of Landau's electrostatic space-charge waves in isotropic hot electron plasmas. The signal spreading from a steadily oscillating dipole sheet is described by an electrostatic Green's function which is synthesized from the spectrum of Landau waves. Numerical results for a Maxwellian plasma show that this signal is rejected below the plasma frequency, penetrates deeply into the plasma slightly above it, and is strongly damped for higher frequencies. Pairs of parallel plane grids immersed into a plasma provide a scheme for launching and detecting Landau waves. This system is described by N-terminal impedance equations from which transconductances and voltage transfer ratios between gridded rf probes are calculated. Results show an optimum width of about 5 Debye lengths for modulating and detecting gaps. Close-range transmission between rf probes is characterized by the exponentially decaying fundamental Landau wave. At larger distances the signal decays as exp $(-x^{2/3})$ due to the persistence of higher-order Landau waves, or even more slowly, as 1/x, if rf currents circulating through ground connections become important. The experiment employs gridded rf probes to excite and detect electrostatic waves within a quiescent collision-free sodium plasma at thermodynamic equilibrium. Exponentially decaying waves with phase velocities between 1.5 and 3 times the electron thermal speed 3×10^7 cm/sec are observed at frequencies between $\omega_p < \omega < 2.5\ \omega_p$. As plasma density and rf frequency are varied, the measured wavelengths and spatial damping rates are scaled to Debye length using independent Langmuir probe data. Full agreement is found between the experimental results and the fundamental solution of Landau's dispersion relation. (auth)

27147 (TID–23760, pp 137-40) GASEOUS ELECTRONICS. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics).

A brief discussion is presented of the time-dependent electron velocity distribution function, $f(\nu,t)$, during the early afterglow of an argon discharge. (M.O.W.)

27148 (TID–23760, pp 141-69) PLASMAS AND CONTROLLED NUCLEAR FUSION. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics).

Brief discussions are presented on the following research areas: beam-plasma discharge, cross-field beam-plasma experiment, sheet models of the beam-plasma discharge with plasma density gradients along the beam, sheet model of a plasma slab, stability criteria for dispersion relations containing branch points, finite Larmor radius effects in the interaction of electrons with hf acoustic waves, oscillations in the hollow-cathode discharge arc, and electron beam interaction with a spatially inhomogeneous temperate plasma. (M.O.W.)

27149 A LONG-LIVED REACTION PRODUCT FROM HELIUM DISCHARGES. Jacobson, C. H. (Univ. of Oklahoma, Norman). Proc. Okla. Acad. Sci., 43: 169-72(1963).

A ternary mixture of electrons, virgin molecules, and ions from these molecules can be obtained in glow discharges. This method may provide quantitative data on the glow discharge, especially with reference to such unstable effects as the constriction under simple density increase. The method consists in operating a pulsed discharge for an interval long enough to allow primary ionization and diffusion to stabilize, but short enough to eliminate chemical reactions between the products of the discharge. The time required for appearance of the first contaminating species and the visibility of this species were determined. The experimental apparatus consisted primarily of a 9-μf capacitor bank, a current-limiting resistor, and a discharge tube. The results are shown in terms of the constriction of the positive column as a function of the number of discharges. There was a marked increase in the constriction of the positive column as the total discharge time (number of discharges times the duration of each) increased. The increase in constriction ceased when the repeated discharges ceased. The constricted column returned very slowly to normal, indicating a long life for the contaminating species. Two days were required for 65% recovery. Several possible explanations for this effect are considered. The most plausible suggestion is that it is a He molecule produced by 3-body collisions between 2 He atoms and a He metastable atom: $He + He + He^* \rightarrow He_2^* + He$. This reaction continues after the current is cut off until the metastable atoms have diffused to the wall. Knowing the distribution of He^* at cutoff and assuming zero population of He^* at the walls, it was possible to solve the diffusion equation in cylindrical symmetry to get the distribution as a function of time after the current cutoff. The time constant of the exponential decay thus found was about 4 msec, making a total reaction time of about 5 msec per pulse. The production rate of He_2^* was calculated to be $\sim 4.6 \times 10^{12}$ molecules/cm^3/pulse. After 200 pulses of current, the concentration could rise to about 0.006 of the total gas concentration. The decay time of these molecules was consistent with their annihilating each other in pairs with the formation of an ion, with a cross-section 10^{-6} times as large as the elastic cross section. The decay time was too long for destruction to occur by wall collisions. (BBB)

27150 MOVEMENT AND SPREAD OF HETEROGENEITIES IN PLASMA. Gurevich, A. V.; Tsedilina, E. E. (Lebedev Inst. of Physics, Moscow. Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Usp. Fiz. Nauk, 91: 609-43(Apr. 1967). (In Russian).

The occurrence of electric and magnetic fields in a plasma has an effect on the spread of heterogeneities. As a result of a difference in the diffusion and drift velocities, the electron and ion components of a heterogeneous volume tend to separate and form an internal electric field which slows down the fast particles and accelerates the slow particles. The internal electric field and associated internal magnetic field determine the velocity and spread of the inhomogeneity. The diffusion spread of an inhomogeneity in a plasma in a magnetic field is considered. In the absence of an external magnetic field this process reduces to one of ordinary ambipolar diffusion. The effect of an internal electric field on the motion of electrons and ions in an anisotropic plasma leads not only to a change in the diffusion coefficient, but also to the appearance of closed electric currents. Hence, diffusion spread of an inhomogeneity in a plasma in a magnetic field is qualitatively different from ordinary diffusion. It is also shown that the internal electric field has a strong effect on the drift of charged particles due to inhomogeneity of the magnetic field, an external electric field or a wind of neutral molecules. (TTT)

27151 THEORY OF ELECTROSTATIC OSCILLATIONS IN A VLASOV-PLASMA IN EXTERNAL ELECTRICAL FIELD. Kolley, Winfried (Karl-Marx-Univ., Leipzig). Beitr. Plasmaphys., 6: 417-30(1966). (In German).

Longitudinal plasma oscillations under the action of an external homogeneous time dependent electric field are examined with regard to the stability of the plasma. The basic model is an infinitely extended collisionless quasineutral two-component plasma. Starting from the linearized Vlasov equation dispersion relations are derived and discussed. It is shown that for an isothermal two-component plasma instabilities are possible, and limits for the area of instability are given. Further, a second method of solution starting from an integral equation for the internal electric field is developed. The equivalence of both methods is shown by means of special cases. (auth)

27152 TENSOR OF THE DIELECTRIC CONSTANT FOR A CYLINDRICAL PLASMOID. Kilimann, K. (Univ., Rostock, Ger.). Beitr. Plasmaphys., 6: 389-407(1966). (In German).

The consideration of a mean electric field, whose occurrence appears as a natural result of the spatial limitations of a plasmoid and the connected deviation from electrical neutrality, leads to corrections in the conductivity and dielectric constant tensor of the system. The corrections are proportional to one of the small parameters $\mu = \tilde{\omega}^2/2(\omega_L)^2$, where $\tilde{\omega}^2$ represents a measurement for the present excess charge on the axis of the cylindrical plasmoid.

If the value of the external magnetic field falls below a critical value, then electron neutrality occurs and the correctors disappear. (tr-auth)

27153 CHOICE OF A METHOD OF ESTIMATING THE CROSS SECTION OF STEPWISE EXCITATION. Tolmachev, Yu. A. Opt. Spectros. (USSR) (Engl. Transl.), 22: 84-6(Jan. 1967). Translated from Opt. Spektros., 22: 162-5(Jan. 1967).

Simple formulas previously derived on the basis of classical physics methods can be used to estimate cross sections for stepwise excitation in medium-pressure plasmas. It is shown that at sufficiently high electron temperatures the stepwise excitation of allowed transitions has much higher efficiency than that of forbidden transitions, and in those cases when the populations of the lower levels do not differ too much, it is sufficient to take only the former into account, using Bethe's formula for the cross-section calculation. (M.H.R.)

27154 EIGENVALUE PROBLEM FOR LAGRANGIAN SYSTEMS. Barston, E. M. (New York Univ., New York). Contract AT(30-1)-1480. J. Math. Phys. (N. Y.), 8: 523-32(Mar. 1967).

The problem of small oscillations about a state of steady motion of a Lagrangian system is considered. Upper and lower bounds for the growth rates of unstable systems are obtained; sufficient conditions for instability are given for finite dimensional systems; an existence theorem for stable modes for systems with an infinite number of degrees of freedom is presented (valid when the operators are completely continuous in Hilbert space); and finally the orthogonality and completeness properties of the modes of stable finite dimensional systems are discussed. (auth)

27155 WEBER'S MIXED BOUNDARY-VALUE PROBLEM IN ELECTRODYNAMICS. Laporte, O. (Univ. of Michigan, Ann Arbor); Fowler, R. G. J. Math. Phys. (N. Y.), 8: 518-22(Mar. 1967).

Electrodynamics problems with mixed boundary values promise to assume increasing practical importance in fields such as plasma physics. A new method of attacking such problems in three dimensions is presented and discussed. (auth)

27156 DERIVATIONS OF HIERARCHIES FOR N-PARTICLE SYSTEMS AND VLASOV SYSTEMS BY MEANS OF THE FUNCTIONAL CALCULUS. Nakayama, Toshio; Dawson, John M. (Nagoya Univ., Japan). J. Math. Phys. (N. Y.), 8: 553-60(Mar. 1967).

The methods of the functional calculus are applied to the Klimontovich equation and to the Vlasov equations. The equation for the generating functional is derived for both cases. By taking moments of these equations, the BBGKY hierarchy is obtained for the case of the Klimontovich equation, and a similar hierarchy is obtained for the case of the Vlasov equation. The two hierarchies are identical, except for some terms involving individual particle interactions. Methods of solving the Vlasov hierarchy are discussed and it is shown how quasi-linear theory can be obtained. (auth)

27157 COUPLED WAVE EQUATIONS FOR PROPAGATION IN GENERALLY INHOMOGENEOUS COMPRESSIBLE MAGNETOPLASMAS. Burman, R. (Victoria Univ., Wellington, New Zealand). Proc. IEEE (Inst. Elec. Electron. Eng.), 55: 723-4(May 1967).

The propagation of coupled electromagnetic and electroacoustic waves in a magnetized, compressible, generally inhomogeneous electron plasma is discussed. Some second-order coupled wave equations are derived. (auth)

27158 WAVEGUIDES AND CAVITIES CONTAINING A HOT GYROTROPIC PLASMA. Gardiol, Fred E. (Univ. of Louvain, Belg.). Proc. IEEE (Inst. Elec. Electron. Eng.), 55: 734-5(May 1967).

Interactions between electromagnetic fields and plasma in waveguides and cavities are analyzed. The treatment refers to a hot, inhomogeneous, collisionless electron plasma in a magnetic field, described by the linearized transport equations. The permittivity operator is introduced and variational principles are derived. (auth)

27159 DESTRUCTION OF STRAIGHT MAGNETIC-SOUND SHOCK WAVES IN A RAREFIED PLASMA AT HIGH MACH NUMBERS. Zagorodnikov, S. P.; Smolkin, G. E.; Sholin, G. V. Zh. Eksp. Teor. Fiz., 52: 1178-83(May 1967). (In Russian).

Experiments on large amplitude straight cylindrical magnetic-sound waves in a rarefied plasma are described. At relatively small magnetic Mach numbers ($\mu < \mu_{\kappa p}$) waves with a steep front are observed, their duration being of the order of $\tau_e \approx 11c\sqrt{mM}/eH$ and width $\delta_e = (10 \text{ to } 12)c/\omega_{pe}$. For $\mu > \mu_{\kappa p}$ a wave with a steep front is first formed on the initial part of the path, its duration being $\sim\tau_e$ and the width $\sim\delta_e$; subsequently these parameters sharply increase by an order of magnitude in the central region of the plasma column. The observed effect is interpreted as a destruction of magnetic-sound waves as a result of formation of oppositely moving ion beams and buildup of ion–ion instability at Mach numbers $\mu > \mu_{\kappa p}$. (auth)

27160 QUASILINEAR THEORY OF RUNAWAY ELECTRONS. Ryutov, D. D. Zh. Eksp. Teor. Fiz., 52: 1378-85(May 1967). (In Russian).

Quasilinear effects due to acceleration of a beam of runaway electrons by an external electric field are studied. It is assumed that initially a low-density beam of high-energy electrons exists in the plasma, Coulomb collisions between the electrons and the plasma electrons and ions being insignificant. The electric field is assumed to be small compared with the critical Dreicer field for which all plasma electrons begin to accelerate with respect to the ions. A solution of the quasilinear equations is found by taking into account the effect of the external electric field and collisions between the plasma electrons and ions. The time dependence of the noise spectrum excited by the beam is determined. The results of the theory may be useful in interpreting the experiments performed on installations of the "Tokamak" and "Stellarator" types. (auth)

27161 NONLINEAR INTERACTIONS OF WAVES IN A WEAKLY TURBULENT PLASMA WITH THE PARTICIPATION OF ION SOUND. Kingsep, A. S. Zh. Eksp. Teor. Fiz., 52: 1386-92(May 1967). (In Russian).

Nonlinear processes involving ion–acoustic waves which are described as a gas of quasiparticles are considered. It is shown that within the limits of applicability of the method the results for three-plasmon processes and scattering of sound on particles are identical with the expressions obtained by the regular method. Expressions are obtained for turbulent shift of the sound frequency and equations describing scattering of sound on sound are derived. (auth)

27162 MECHANICAL EFFECTS ON ELECTRODE DURING PLASMA CUMULATION NEAR THE AXIS. Godunov, S. K.; Filippov, N. V.; Filippova, T. I. Zh. Eksp. Teor. Fiz., 52: 1134-45 (May 1967). (In Russian).

Brief contact between a gas discharge plasma at over 10^7 °K and a metallic electrode not only results in intensive evaporation of the surface but in some cases, due to the high pulsed pressures which may be as high as several megabars, leads to shock-wave destruction of the external side of the electrode, i.e., to rear cleavage. A deuterium plasma with an energy content sufficient to produce such pulsed pressures for a period of $\sim 10^{-7}$ sec has been obtained by noncylindrical compression of a z pinch. The cleavage phenomenon was used in an attempt to determine the pulsed pressure (or energy content) in the plasma focus. For this purpose calculations are carried out in the model plane problem on traversal of a shock wave through an aluminum plate and reflection of the wave from a free boundary. The dependence of the thickness of the cleaved layer on the pressure amplitude is found for a given pulse shape corresponding to a prescribed duration. An analysis of the experimental results based on the calculations shows that the energy density on the plasma focus may reach 10^{23} to 10^{24} $\mathrm{eV \cdot cm^{-3}}$ in agreement with other independent estimations. Thus the cleavage method may be employed for diagnostics of dense hot plasmas. (auth)

27163 INFLUENCE OF THE METASTABLE He I 2^3S LEVEL ON HELIUM PLASMA COMPONENTS. Bohn, W. L. (Institut fuer Plasmadynamik, Stuttgart). Z. Naturforsch., 22a: 139-41 (Jan. 1967). (In German).

The effect of the metastable He I 2^3S level on the He plasma components was calculated for an optically thin stationary plasma. The results show that at constant pressure the maximum of the number of electrons in the shell of He I 2^3S is in the vicinity of the intersection point of the neutral and ionized He component. The role of the transition from the metastable level to the singlet system is without great significance in the electron density considered. (J.S.R.)

27164 STATISTICAL THEORY OF INELASTIC PROCESSES IN A PLASMA. I. KINETIC EQUATIONS FOR A COULOMB PLASMA IN WHICH INELASTIC PROCESSES ARE TAKEN INTO ACCOUNT. Klimontovich, Yu. L. (Moscow State Univ.). Zh. Eksp. Teor. Fiz., 52: 1233-45(May 1967). (In Russian).

A method is developed for describing nonequilibrium processes in a partially ionized plasma by taking into account inelastic processes. The initial equation set is that for four operator density matrices which describe the states of free and coupled charged-particle pairs (electrons and ions) as well as transitions from bound states to free ones and vice versa. The equations are considered simultaneously with those for the microscopic electromagnetic field strengths. Expressions in which inelastic processes are taken into account are obtained for the field spectral functions, and a kinetic equation set for the electron, ion, and atom distribution functions are obtained in which inelastic processes are taken into account. The properties of the collision integrals are such that they ensure conservation of the total number of charged particles, total momentum, and energy. The Maxwell–Boltzmann distribution is the equilibrium solution of the equation set under conditions of chemical (ionization) equilibrium. The approximation in which the kinetic equations have been derived corresponds to the Born approximation for elastic and inelastic processes providing that atomic motions and polarization of the medium have been taken into account. Polarization of the medium is due to four processes: to the motion of free charged particles, to variation of the internal state of the atoms and to transitions of charged particles from the bound state to a free one or vice versa. An equation set for the electron, ion and atomic concentration is derived with aid of the kinetic equations. The ionization coefficient for longitudinal electric field quanta is calculated. The expressions for the equilibrium ionization and recombination coefficients of colliding particles are considered. (auth)

27165 IONIZATION WAVES IN SEMICONDUCTORS AND GASEOUS PLASMAS. Weissglas, Peter; Andersson, Bengt (Royal Inst. of Tech., Stockholm. Uppsala Univ.). J. Appl. Phys., 38: 2185-91(Apr. 1967).

A theory for ionization waves in plasmas is developed. If the ionization rate depends strongly on carrier temperature such waves may propagate and an instability, which in some cases is absolute, can occur. The wave has a phase velocity opposite the electron drift and can have either positive or negative group velocity. The theory agrees qualitatively, but not in detail, with that previously developed by Pekarek for striations in gaseous discharges. In particular, the theory is applied to InSb, which is a favorable solid-state material for observations of ionization waves. Instabilities are predicted for thin layers of intrinsic material. It is also shown that the temperature dependence of the ambipolar diffusion coefficient can give rise to an instability that is independent of the ionization phenomena. (auth)

27166 SIMILARITY RELATIONS FOR DISCHARGE COLUMNS IN RARE GASES AT AVERAGE PRESSURES. **Venzke, Dieter; Hayess, Erhard; Wojaczek, Karl (Physikalisch-Technisches Institut, Berlin). Beitr. Plasmaphys., 6: 365-75(1966). (In German).**

At constant wall temperature, contracted discharge columns in rare gases at average pressures are established by the specifications of Rp and i/R, where R is the tube radius, p the gas pressure, and i the discharge current intensity. This was experimentally verified by investigations on discharge tubes filled with Ar and Ne with a tube radius between 1 and 7 cm. (tr-auth)

27167 SOUND PULSES IN LOW PRESSURE PLASMAS. I. PRODUCTION AND DETECTION OF SOUND PULSES. **Hayess, Erhard (Physikalisch-Technisches Institut, Berlin). Beitr. Plasmaphys., 6: 377-87(1966). (In German).**

For sound production in low-pressure discharges, a local pulse-auxiliary discharge can be used. It was shown on the basis of experimental data that sound production occurs by a local heating of the neutral gas in the area of the excitation electrode. One-directional layered sound pulse occurs. In the propagation through the discharge column this sound pulse moves the electrically active plasma components to temporarily strongly damped oscillations which can be detected by photoelectric methods. The propagation velocity and the spatial damping of the optically observed wave train are characteristic of the sound propagation. (tr-auth)

27168 ANODE LOSSES IN COAXIAL HALL CURRENT ACCELERATORS. **Hassan, H. A.; Garrison, G. W. Jr. (North Carolina State Univ., Raleigh). AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 5: 840-3(May 1967).**

Analysis of anode power losses in a coaxial Hall current accelerator is presented. Both the anode and cathode sheaths are assumed to be less than a mean free path. Outside the sheaths, the governing equations are the conservation equations of a partially ionized gas in the presence of electric and magnetic fields and nonequilibrium ionization. In these equations, the loss mechanism is a result of conduction and diffusion of electrons, ions, and neutrals. A simple geometry consisting of an inner cathode and an outer ring anode combined with an axial magnetic field is considered. The calculations carried out here show that the anode power loss increases with an increase in magnetic field strength and/or total current. Also, if the viscous dissipation is small compared to the power input, the anode power loss is independent of the mass flow rate. The results also show that, for the range considered here, the electron contribution to the anode power loss increases and then decreases with an increase in magnetic field strength. (auth)

27169 TENSOR ELECTRICAL CONDUCTIVITY OF ATMOSPHERIC CESIUM-SEEDED ARGON. **Schweitzer, S. (Univ. of Pennsylvania, Philadelphia). AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 5: 844-7(May 1967).**

The third Chapman–Enskog approximation to the tensor electrical conductivity of a partially ionized gas is applied to evaluate two conductivity mixture rules. The so-called mean-free-path mixture rule and a recently proposed integral-mixture rule are examined for cesium-seeded argon at atmospheric pressure in the temperature range of 1400 to 3000°K. Upper and lower bounds of actual electron–neutral cross sections are used in the calculations. It is shown that under certain conditions of seeding and Hall parameter, the integral-mixture rule may yield results that should be correct within 20%. The effect of uncertainties in electron–neutral cross sections is shown to diminish with increased values of the Hall parameter. (auth)

27170 QUASILINEAR THEORY OF OSCILLATIONS OF A MAGNETO-ACTIVE PLASMA. **Sizonenko, V. L.; Stepanov, K. N. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh., 12: 535-45(Apr. 1967). (In Russian).**

Equations are obtained of the quasilinear theory for oscillations of a magnetoactive plasma with a strong spatial dispersion, when the phase velocity of the electromagnetic waves is of the order or less than the thermal velocity of the plasma particles. It is shown that various components of the electric field have various nonlinear damping decrements. The difference in damping decrements is of the order of the reciprocal time of the relaxation of the resonance particle distribution function as a result of diffusion by the waves. (auth)

27171 STATE CONTROL OF A FLOWING PLASMA BY MEANS OF RADIO FREQUENCY ELECTROMAGNETIC FIELDS. **Vermeulen, P. J. (Manchester Univ., Eng.); Boddie, W. Lee; Wierum, F. A. AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 5: 1015-17(May 1967).**

Coupling of an rf electromagnetic field to a thermal plasma flow was readily and stably accomplished, and some evidence of state control in the transition regime was obtained. The theoretical results indicate that the temperature distribution can be controlled towards a uniform temperature by varying the field frequency. (auth)

27172 COUPLING EFFICIENCY OF THE RADIO FREQUENCY PLASMA TORCH. **Scholz, Paul D.; Brodwin, Morris E.; Anderson, Thomas P. (Northwestern Univ., Evanston, Ill.). AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 5: 1022-4(May 1967).**

The rf plasma torch depends on an inductive coupling between plasma and the time-varying, axial magnetic field within a solenoid. The solenoid with the plasma is part of the plate circuit of an oscillator. The effectiveness of the coupling between the oscillator and plasma is given by the coupling efficiency. The coupling efficiency, which is defined as the ratio of plasma power (i.e., heat energy dissipated per sec in the plasma) to the dc oscillator input power is determined and checked against the analytical results. The experimental efficiencies are determined by a calorimetric method. (M.H.R.)

27173 A SIMPLE METHOD FOR THE DETERMINATION OF THE MEAN FREE PATH OF PRIMARY ELECTRONS IN PLASMA. **Behlke, H.; Drost, H.; Pupke, H. (Institut fuer Biophysik, Berlin). Beitr. Plasmaphys., 6: 299-303(1966). (In German).**

With the help of a sufficiently large retarding grid placed before the cathode it is possible to eliminate, according to the height of the retarding potential, both the secondary electrons and also the total primary current from the probe current. The characteristic lines released from the fraction of the secondary electron can detect clear horizontal areas of the unscattered primary current and thus permit a very accurate determination of the mean free path of primary electrons in plasma. The distance between probe and retarding lattice in which the probe characteristic lines can detect a fraction of the secondary electrons corresponds approximately to the mean free path length of the primary electrons in neutral gas. This was regarded as an indication that through the introduction of a retarded lattice the processes responsible for the mean free path in the cathode region were eliminated which means an increased measurement accuracy of this path. (tr-auth)

27174 LAYER PHENOMENA IN THE POSITIVE COLUMN OF N_2 LOW PRESSURE DISCHARGE. Sabadil, H. (Ernst-Moritz-Arndt-Univ., Greifswald, Ger.). Beitr. Plasmaphys., 6: 305-17 (1966). (In German).

The positive column of the low-pressure discharge in N_2 was investigated with respect to its layer states. The data showed that the positive column in the discharge current under 200 mamp occurs preponderantly in the layered state. Various types of layers are to be observed according to the discharge condition. The so-called T form of the positive column of O_2 discharge is shown as a layered form of the positive column. The properties of these layers are essentially different from the known continuous layers in the rare gases, in N_2, and H_2. They were explained as ion sound waves which represent here a form of ionization–recombination instability. In the so-called H form of the positive column there are discharge conditions under which both positive-continuous and at-rest, and also negative-continuous, layers are to be observed. These favorable conditions permit a derivation, on the basis of the dispersion behavior of the rigid relation between positive-continuous, positive-quiescent, and negative-continuous layers. From data on the effect of N_2 additives to the macroscopic layer, important parameters were given. (tr-auth)

27175 THE POSITIVE COLUMN OF THE Ar LOW-PRESSURE DISCHARGE IN THE TRANSITION REGION. IV. **Wojaczek, Karl (Physikalisch-Technisches Institut, Berlin). Beitr. Plasmaphys., 6: 319-30(1966). (In German).**

On the basis of data obtained earlier on the elementary processes in the positive column of Ar low-pressure discharge the column characteristics were calculated for a wide-variation region of pressure and discharge current intensity. The detailed data of the column parameters were used, on the basis of a simplified model of the layering mechanism, to determine the layer behavior of the positive column as a function of the discharge current intensity. The calculated layer data, especially the site of the upper existence limit of the continuous layer, is in satisfactory agreement with experimental data. The mechanism of the continuous column in the Puppe transition region may therefore be explained in principle. (tr-auth)

27176 ENERGY DISTRIBUTION FUNCTIONS IN THE DROP SPACE OF GLASS DISCHARGES. **Hantzsche, E. (Physikalisch Technisches Institut, Berlin). Beitr. Plasmaphys., 6: 331-43 (1966). (In German).**

Energy distribution functions of electrons, ions, and neutrals in the one-dimensional cathode fall region of anomalous glow discharges in hydrogen are derived by numerical integration of simplified Boltzmann equations for two values of the dark-space voltage (5 kV and 0.45 kV). Molecular and atomic ions and neutrals are treated separately. Charge exchange, ionization, excitation and dissociation are taken into account. (auth)

27177 HEAT FLOW THROUGH A LANGMUIR SHEATH IN THE PRESENCE OF ELECTRON EMISSION. **Hobbs, G. D.; Wesson, J. A. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Plasma Phys., 9: 85-7(Jan.-Feb. 1967).**

Calculations of the heat flow through the sheath are described, and the effect of the electrons emitted by the wall is demonstrated. (UK)

27178 CHARACTERISTICS OF LARGE AMPLITUDE ALFVEN WAVES IN A LABORATORY PLASMA. **Brown, I. G.; Watson-Munro, C. N. (Univ. of Sydney). Plasma Phys., 9: 43-52(Jan.-Feb. 1967).**

A study was made in a cylindrical hydrogenous laboratory plasma of a number of features of the propagation of Alfvén waves whose wave magnetic field (B_θ) was small compared to the static field (B_0). (UK)

27179 PULSE-STIMULATED RADIATION FROM A PLASMA DUE TO AN ENERGY-DEPENDENT GYROFREQUENCY. **Kegel, W. H. (California Inst. of Tech., Pasadena). Plasma Phys., 9: 23-38(Jan.-Feb. 1967).**

A plasma excited by two short pulses at the electron gyrofrequency, having a time separation τ, is considered in the single particle approach. It is shown that the relativistic mass effect can lead to a series of radiation maxima after the second pulse. The shape of the radiation maxima is given by the square of the Fourier transform of the distribution of the inhomogeneities or the initial energies. The two effects have a tendency to cancel each other. (UK)

27180 CONICAL Z-PINCH PLASMA GUN. **Fearn, D. G.; Wooding, E. R. (University Coll. of Wales, Aberystwyth). Brit. J. Appl. Phys., 18: 213-18(Feb. 1967).**

An investigation of a conical z-pinch plasma gun, using a high-speed camera and magnetic probes showed that a conical current sheet implodes to form a highly luminous axial pinch. The plasma and the current sheet at the muzzle of the gun are always symmetrical about the axis. The interaction between the azimuthal magnetic field and the current sheet ejects a plasma blob containing more than 10% of the injected gas. The conversion efficiency of capacitor energy into flow energy is 3%. A second, slower, plasma blob is also ejected. (auth)

27181 WAVE PROPAGATION IN A GUIDE PARTIALLY OR COMPLETELY FILLED BY A PLASMA-ELECTRON BEAM SYSTEM. **Bouchoule, Andre; Bliman, Samuel (Institut d'Electronique Fondamentale, Essone, France). Compt. Rend., Ser. B, 264: 209-12(Jan. 16, 1967). (In French).**

In a preceding study a calculation making it possible to obtain the dispersion equation of waves being propagated in a guide containing a plasma beam system in the presence of a uniform continuous magnetic induction directed along the Oz axis of the guide was presented. In the present study the solutions representing two particular cases are given, the guide completely filled and the column in a dielectric of infinite transverse dimension. (tr-auth)

27182 ELECTRON RECOMBINATION IN AN Ar PLASMA UNDER ATMOSPHERIC PRESSURE IN THE VICINITY OF 10,000°K. **Nguyen Van Trong (SEA, Courbevoie, Seine, France). Compt. Rend., Ser. B, 217-19(Jan. 16, 1967). (In French).**

The Finkelnburg and Peters theory on continuous emission in the visible region was used to study electron recombination in an Ar plasma torch. A generator with frequency 1.5 MHz and power of 10 kW was used. The initial electron density of the plasma was 1.4×10^{16} e/cm^3 and the temperature corresponded to 9,800°K. (tr-auth)

27183 NONLINEAR EXTRAORDINARY WAVES IN A COLD PLASMA. **Boyd, T. J. M. (St. Andrews Univ., Scotland). Phys. Fluids, 10: 896-8(Apr. 1967).**

The methods of Bogoliubov, Krylov, and Mitropolskii which have been generalized and applied recently to various types of plasma waves are used to calculate the frequency shift associated with the nonlinear extraordinary wave in a cold plasma. (auth)

27184 GENERATION OF VORTICITY BY WAVES IN A PLASMA. **Ross, James A.; Ingard, Uno (Massachusetts Inst. of Tech., Cambridge). Phys. Fluids, 10: 899-900(Apr. 1967).**

The analysis of the generation of vorticity by waves in a neutral gas is extended to the case of a plasma. It is shown that waves can interact with a plasma in a uniform magnetic field to generate vorticity. (auth)

27185 CORRELATION FUNCTIONS AND COMPRESSION OF NONISOTHERMAL PLASMA. **Medvedev, E. S. (Inst. of Physical Chemistry, Moscow). Phys. Lett., 24A: 559-60(May 8, 1967). (In French).**

The presence of the "slow" waves in a plasma with two different temperatures gives rise to strong correlations in the positions of the particles. The additional pressure ΔP due to the Coulomb interaction is shown to be positive ($\Delta P < 0$). (auth)

27186 NONLINEAR EFFECTS OF FLUCTUATIONS IN A CURRENT-CARRYING PLASMA. **Pearson, Gary A. (Univ. of California, Berkeley. Bell Telephone Labs., Inc., Murray Hill, N. J.). Phys. Fluids, 10: 685-95(Apr. 1967).**

A current-carrying electron–proton plasma is studied by calculating the velocity distribution of the particles with the Lenard–Balescu–Guernsey form of the Fokker–Planck equations rather than with the familiar Landau form. The Landau equations yield velocity distributions that become unstable to longitudinal ion waves when the temperature ratio T_e/T_i is large and the electric field E_0 that drives the current exceeds a critical magnitude E_{crit}. The Landau equations are then not appropriate because they do not include the effect that the fluctuations associated with these ion waves have upon the velocity distributions. The Lenard–Balescu–Guernsey equations show that as E_0 is increased toward E_{crit} these fluctuations increase and affect the electron velocity distribution much as enhanced electron–electron collisions would do. In particular, this nonlinear process reduces the electrical conductivity by a noticeable amount (a few percent in the examples given). Although one might also expect the threshold electric field for instability to be increased significantly, this effect is found to be extremely weak, if it exists. (auth)

27187 FOURIER–HERMITE SOLUTIONS OF THE VLASOV EQUATIONS IN THE LINEARIZED LIMIT. **Grant, Frederick C.; Feix, Marc R. (Langley Research Center, Hampton, Va.). Phys. Fluids, 10: 696-702(Apr. 1967).**

The properties of the Fourier–Hermite transformation of the one-dimensional Vlasov equation for the motion of electrons against a uniform positive neutralizing background are examined in the linearized limit. The general dispersion relation is presented for the transformed equations. Numerical and analytical results are given which show the recovery of Landau damping for Maxwell's distribution even though the corresponding eigenfrequencies are always real. An example of double streaming is treated to show the appearance of imaginary eigenfrequencies in the analysis. Introduction of a small number of collisions is shown to improve the long-term behavior. Nonlinear numerical results for the nearly cold plasma are shown to agree with the exact treatment of Kalman. (auth)

27188 KINETIC EQUATION WITH ELECTROMAGNETIC INTERACTIONS. **Hogan, J. T.; Lewis, M. B. (Northwestern Univ., Evanston, Ill.). Phys. Fluids, 10: 723-30(Apr. 1967).**

A kinetic equation for a plasma with electromagnetic interactions is derived in the shielding approximation. The equation is the analog of the Landau equation and has the same structure as the Landau equation but with a velocity dependent interaction replacing the Coulomb interaction. (auth)

27189 TRANSPORT COEFFICIENTS IN A PLASMA. I. PURE GAS. Braun, E. (Comision Nacional de Energia Nuclear, Mexico City). Phys. Fluids, 10: 731-6(Apr. 1967).

The Lenard – Balescu kinetic equation for a one-component inhomogeneous plasma is solved by the Chapman – Enskog method. The transport coefficients are calculated taking into account collective effects. For most plasmas of interest it is found, to a first approximation, that the value of these coefficients is diminished as compared to that obtained using the Boltzmann – Landau kinetic equation and cutting off integrals at the Debye distance. The higher approximations are very small compared to the first one. (auth)

27190 TRANSPORT COEFFICIENTS IN A PLASMA. II. BINARY MIXTURE. Braun, E. (Comision Nacional de Energia Nuclear, Mexico City). Phys. Fluids, 10: 737-40(Apr. 1967).

The transport coefficients for a binary plasma are calculated starting from the Lenard – Balescu kinetic equation. The results show that for most plasmas of interest the value of the coefficients is diminished as compared to those obtained from the Boltzmann – Landau kinetic equation. (auth)

27191 ANOMALOUS SKIN EFFECT IN A PLASMA. Weibel, Erich S. (Laboratoire de Recherches en Physique des Plasmas, Lausanne, Switzerland). Phys. Fluids, 10: 741-8(Apr. 1967).

The theory of the skin effect in a plasma is developed for the case in which the relation between current and electric field is not local. (auth)

27192 SELF-CONSISTENT TIME-OF-FLIGHT ANALYSIS OF A PLASMA GUN. Manka, C. K.; Crawford, J. R.; Zinke, O. H. (Univ. of Arkansas, Fayetteville). Phys. Fluids, 10: 767-73 (Apr. 1967).

The numbers, flow velocities, and temperatures of the positive ions emitted by helium and argon plasmas pulsed into an evacuated region by a plasma gun are determined by a time-of-flight analysis on freely expanding ions. Times of plasma release are also calculated. It is shown that the time-of-flight technique is applicable even with statistical variations in plasma characteristics observed under apparently identical conditions of plasma production. A slug-mode description of the average behavior of the gun is seen to agree with the time-of-flight analysis if ion recombination is assumed. (auth)

27193 DIFFUSIVE SEPARATION OF IONS AND ATOMS IN A SHOCK WAVE. Sinclair, M.; Sonin, A. A.; de Leeuw, J. H. (Univ. of Toronto). Phys. Fluids, 10: 891-3(Apr. 1967).

The structure of shock waves in slightly ionized high-electron-temperature plasmas is found to be appreciably modified by diffusive broadening induced by electrical coupling of the ions with the hot electrons. (auth)

27194 COLLECTIVE OSCILLATIONS IN A PLASMA. Akhiezer, A. I.; Akhiezer, I. A.; Polovin, R. V.; Sitenko, A. G.; Stepanov, K. N. International Series of Monographs in Natural Philosophy. Volume 7. New York, Pergamon Press, 1967. 200p. $7.25.

Translation of Kollektivnye Kolebaniya v Plazme by H. S. H. Massey.

Five chapters are devoted to the following topics: spectra of eigen oscillations of a free plasma, spectra of plasma oscillations in a magnetic field, stable and unstable particle distributions in a plasma, fluctuations in a plasma, and wave scattering and transformation and scattering of charged particles in a plasma. (M.O.W.)

Production of Plasma

27195 (AD–640728) HIGH-TEMPERATURE STABILIZED ELECTRIC ARCS OF HIGH POWER (ELECTRIC ARC PLASMOTRONS). Tikhonov, V. B.; Yakovlev, E. A. Translated from Tr. Mosk. Aviats. Inst., Sb. Statei, No. 119, 43-71(1960). 40p. (FTD-TT-65-1405). CFSTI.

Separate discussions are presented on: the apparatus and operating principles of electric-arc plasmatrons, the arc-discharge plasma, spectroscopic investigation of the emission from the channel and the high-temperature jet of an electric-arc plasmatron, and the influence of the electromagnetic field on the plasma motion in the arc-discharge channel. (M.O.W.)

27196 (D–1–82–0581) PLASMA RADIATION BY ROUGH SURFACES. Stern, Edward A. (Washington Univ., Seattle. Boeing Scientific Research Labs., Seattle, Wash. Plasma Physics Lab.). Nov. 1966. 14p.

The recent observation of a peak of scattered radiation at the plasma frequency from thin silver foils irradiated with light can be explained in terms of a small amount of surface roughness of the foils. The theory of such scattered radiation is presented and suggests that this phenomenon can be used to study the surface roughness of the foil. (auth)

27197 (N–67–15960) CALCULATION OF THE EFFECT OF VISCOUS DRAG ON THE PERFORMANCE OF A COAXIAL PLASMA GUN. Norwood, Joseph Jr. (National Aeronautics and Space Administration, Langley Station, Va. Langley Research Center). Jan. 1967. 27p. (NASA-TN–D-3796). CFSTI $3.00 cy, $0.65 mn.

It is shown that under the assumptions of ionic impact as the dominant emission process in coaxial pulsed plasma guns and the second Townsend ionization coefficient much smaller than unity, a viscous drag force results which imposes a velocity limitation on the accelerated plasma. Calculations are presented to show that for operating conditions which optimize efficiency, the effect can seriously degrade the gun performance, particularly for those cases where the stored energy is small and where the current is oscillatory during the acceleration. (auth)

27198 (ORNL–4080) ORNL TARGET PLASMA PROGRAM. Dandl, R. A.; Guest, G. E.; Lazar, N. H. (Oak Ridge National Lab., Tenn.). Apr. 1967. Contract W-7405-eng-26. 20p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

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27204 PLASMA GUN. Bensussan, Andre-Marc; Papillon, Yves (to Commissariat a l'Energie Atomique). British Patent 1,068,788. May 17, 1967. Priority date Sept. 7, 1964, France.

A plasma gun is described which uses the chemical properties of titanium in a hydrogen generating element made of powdered titanium hydride agglomerated with an electrical insulating binder in a quantity determined according to the particle size distribution of the hydride employed. (M.H.R.)

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A process for obtaining an ion-electron plasma having a high kinetic temperature and a high concentration of ions and electrons is described. This process includes creating a magnetic confining field in an evacuated chamber and introducing a radioisotope gas to provide relativistic electrons by radioactive decomposition simultaneously with injection of electrically neutral gas molecules into the magnetic field, thereby trapping the electrons. The injected neutral gas molecules are ionized by interaction with the energetic electrons. A second electrically neutral gas is then introduced into the confining magnetic field to replace the ionized first gas with ions of the second gas. The confined plasma of energetic electrons and ions of the second gas is compressed. Energetic ions are then injected into the field to interact with the contained particle plasma to produce an energetic plasma of atomic ions and electrons. (M.H.R.)

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The higher-order modes of electrostatic oscillations in transversely bounded and/or inhomogeneous Vlasov plasmas are studied using the generalized formulas and stability criteria reported in a recent paper. While modes higher than the lowest are unimportant in stationary warm plasmas because they are strongly damped, it is found that in counterstreaming plasmas, there are in general several unstable modes, the number of which depends tions is derived in the shielding approximation. The equation is the analog of the Landau equation and has the same structure as the Landau equation but with a velocity dependent interaction replacing the Coulomb interaction. (auth)

27189 TRANSPORT COEFFICIENTS IN A PLASMA. I. PURE GAS. Braun, E. (Comision Nacional de Energia Nuclear, Mexico City). Phys. Fluids, 10: 731-6(Apr. 1967).

The Lenard–Balescu kinetic equation for a one-component inhomogeneous plasma is solved by the Chapman–Enskog method. The transport coefficients are calculated taking into account collective effects. For most plasmas of interest it is found, to a first approximation, that the value of these coefficients is diminished as compared to that obtained using the Boltzmann–Landau kinetic equation and cutting off integrals at the Debye distance. The higher approximations are very small compared to the first one. (auth)

27190 TRANSPORT COEFFICIENTS IN A PLASMA. II. BINARY MIXTURE. Braun, E. (Comision Nacional de Energia Nuclear, Mexico City). Phys. Fluids, 10: 737-40(Apr. 1967).

The transport coefficients for a binary plasma are calculated starting from the Lenard–Balescu kinetic equation. The results show that for most plasmas of interest the value of the coefficients is diminished as compared to those obtained from the Boltzmann–Landau kinetic equation. (auth)

27191 ANOMALOUS SKIN EFFECT IN A PLASMA. Weibel, Erich S. (Laboratoire de Recherches en Physique des Plasmas, Lausanne, Switzerland). Phys. Fluids, 10: 741-8(Apr. 1967).

The theory of the skin effect in a plasma is developed for the case in which the relation between current and electric field is not local. (auth)

27192 SELF-CONSISTENT TIME-OF-FLIGHT ANALYSIS OF A PLASMA GUN. Manka, C. K.; Crawford, J. R.; Zinke, O. H. (Univ. of Arkansas, Fayetteville). Phys. Fluids, 10: 767-73 (Apr. 1967).

The numbers, flow velocities, and temperatures of the positive ions emitted by helium and argon plasmas pulsed into an evacuated region by a plasma gun are determined by a time-of-flight analysis on freely expanding ions. Times of plasma release are also calculated. It is shown that the time-of-flight technique is applicable even with statistical variations in plasma characteristics observed under apparently identical conditions of plasma production. A slug-mode description of the average behavior of the gun is seen to agree with the time-of-flight analysis if ion recombination is assumed. (auth)

27193 DIFFUSIVE SEPARATION OF IONS AND ATOMS IN A SHOCK WAVE. Sinclair, M.; Sonin, A. A.; de Leeuw, J. H. (Univ. of Toronto). Phys. Fluids, 10: 891-3(Apr. 1967).

The structure of shock waves in slightly ionized high-electron-temperature plasmas is found to be appreciably modified by diffusive broadening induced by electrical coupling of the ions with the hot electrons. (auth)

27194 COLLECTIVE OSCILLATIONS IN A PLASMA. Akhiezer, A. I.; Akhiezer, I. A.; Polovin, R. V.; Sitenko, A. G.; Stepanov, K. N. International Series of Monographs in Natural Philosophy. Volume 7. New York, Pergamon Press, 1967. 200p. $7.25.

Translation of Kollektivnye Kolebaniya v Plazme by H. S. H. Massey.

Five chapters are devoted to the following topics: spectra of eigen oscillations of a free plasma, spectra of plasma oscillations in a magnetic field, stable and unstable particle distributions in a plasma, fluctuations in a plasma, and wave scattering and transformation and scattering of charged particles in a plasma. (M.O.W.)

Production of Plasma

27195 (AD–640728) HIGH-TEMPERATURE STABILIZED ELECTRIC ARCS OF HIGH POWER (ELECTRIC ARC PLASMOTRONS). Tikhonov, V. B.; Yakovlev, E. A. Translated from Tr. Mosk. Aviats. Inst., Sb. Statei, No. 119, 43-71(1960). 40p. (FTD-TT-65-1405). CFSTI.

Separate discussions are presented on: the apparatus and operating principles of electric-arc plasmatrons, the arc-discharge plasma, spectroscopic investigation of the emission from the channel and the high-temperature jet of an electric-arc plasmatron, and the influence of the electromagnetic field on the plasma motion in the arc-discharge channel. (M.O.W.)

27196 (D–1-82-0581) PLASMA RADIATION BY ROUGH SURFACES. Stern, Edward A. (Washington Univ., Seattle. Boeing Scientific Research Labs., Seattle, Wash. Plasma Physics Lab.). Nov. 1966. 14p.

The recent observation of a peak of scattered radiation at the plasma frequency from thin silver foils irradiated with light can be explained in terms of a small amount of surface roughness of the foils. The theory of such scattered radiation is presented and suggests that this phenomenon can be used to study the surface roughness of the foil. (auth)

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27213 HIGHER-ORDER MODES OF THE TWO-STREAM INSTABILITY IN BOUNDED AND/OR INHOMOGENEOUS PLASMAS. Lee, Kai Fong (Univ. of California, San Diego, La Jolla). J. Appl. Phys., 38: 2172-8(Apr. 1967).

The higher-order modes of electrostatic oscillations in transversely bounded and/or inhomogeneous Vlasov plasmas are studied using the generalized formulas and stability criteria reported in a recent paper. While modes higher than the lowest are unimportant in stationary warm plasmas because they are strongly damped, it is found that in counterstreaming plasmas, there are in general several unstable modes, the number of which depends on geometry and streaming velocity. For a given plasma temperature and density, it is possible to excite only the lowest mode and suppress all others either by operating at certain ranges of streaming velocities or by suitably choosing the ratio of plasma diameter to that of the surrounding conducting shield. The relevance of these results on the design of double-stream amplifiers is discussed. (auth)

27214 SHOCK-LIKE DRIFT WAVES. **Tasso, H. (Institut fuer Plasmaphysik, Garching, Ger.). Phys. Lett., 24A: 618 (May 22, 1967).**

It is shown that a simple macroscopic plasma model allows for nonlinear shock-like drift waves satisfying Burgers' equation. (auth)

27215 TWO METHODS OF SOLVING THE RADIATIVE INSTABILITY PROBLEM OF A STREAM-PLASMA SYSTEM WITHIN THE KINETIC REGIME. **Fung, P. C. W. (Univ. of Tasmania, Australia). Plasma Phys., 9: 94-6(Jan.-Feb. 1967).**

The two methods generally used in the classical kinetic regime are examined: (i) solving the dispersion equation for the system for complex frequency, considering the dielectric tensor to be made up of two parts, and (ii) deriving the dispersion equation for an electromagnetic wave in the system of a stream in a vacuum in a magnetic field, and then including the presence of a plasma. The approximations involved in the two methods are considered, and it is concluded that in many systems the second approach, mathematically more simple, is a valid approximation of the first. (UK)

27216 EVIDENCE FOR A COHERENT DECELERATION OF AN ELECTRON BEAM DURING THE ELECTRON PLASMA FREQUENCY INSTABILITY. **Hopman, H. J.; Matitti, T.; Vermeer, A.; Kistemaker, J. (FOM-Inst. for Atomic and Molecular Physics, Amsterdam). Plasma Phys., 9: 39-42(Jan.-Feb. 1967).**

An attempt is made to correlate the compression of an interference pattern, produced by electron plasma instability in a beam-plasma experiment, with a deceleration of the electron beam. An estimation of 10 eV for the intensity of plasma oscillations is obtained in He gas. The total hf plus thermal energy of the plasma electrons amounts to 20 eV. (auth)

27217 FLUTE INSTABILITY IN THE PRESENCE OF NONUNIFORM ELECTRIC FIELDS. **Stringer, T. E.; Schmidt, G. (United Kingdom Atomic Energy Authority, Abindgon, Eng.). Plasma Phys., 9: 53-9(Jan.-Feb. 1967).**

A general equation describing the flute instability in a low-β plasma, in the presence of a nonuniform electric field perpendicular to the magnetic field, is derived from guiding center equations. The equations obtained by Rosenbluth and Simon, and by Damm et al., correspond to two different limiting cases of this general equation. The physical significance of various stabilizing terms is discussed. In the high density zero gyro-radius limit, the shear flow resulting from the nonuniform electric field has a destabilizing effect. At low densities the imbalance between the equilibrium ion and electron densities has a significant stabilizing effect. (UK)

27218 ELECTRON-CYCLOTRON INSTABILITY EXPERIMENT. **Morse, D. L. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Plasma Phys., 9: 61-71(Jan.-Feb. 1967). (CLM-P-106).**

Electrostatic oscillations are excited in a cylindrical shell of plasma by an electron beam which passes through the plasma with a helical trajectory. A nonconvective instability results in an unstable wave which propagates in the same azimuthal direction, and in the opposite axial direction, as the electron beam. The qualitative behaviour of the instability is in agreement with the theoretical predictions, and the frequency and wavelength of the unstable wave agree with calculated values to within 25%. (UK)

27219 INSTABILITY OF THE STEADY STATE OF A PLASMA IN A UNIFORM ELECTRIC FIELD. **Reiter, George F. (Stanford Univ., Calif.). Phys. Fluids, 10: 703-10(Apr. 1967).**

The Bhatnagar–Gross–Krook equations are used to obtain the steady-state velocity distribution for a uniform, fully ionized plasma in a dc electric field. The Joule heating of the plasma is assumed to be compensated by volume heat losses such as bremsstrahlung. The distribution obtained is far from Maxwellian if the drift velocity is comparable to the thermal velocity of the electrons. Longitudinal oscillations with wave vector in the direction of the field are introduced as a perturbation and their dispersion relation obtained. The stability of the steady state is investigated numerically, and it is found to be unstable for sufficiently high drift velocities, the instability being due to the familiar electron ion two stream interaction. The instability is impeded but not prevented by collisions. It is found that the critical drift velocity exceeds that calculated in the collisionless theory by about 20% in the limit that the electric field and collision frequency approach zero. This difference is attributable to the modification of the velocity distribution function. (auth)

27220 SCREW INSTABILITY IN A LINEAR HALL ACCELERATOR. **Garrison, G. W. Jr.; Hassan, H. A. (North Carolina State Univ., Raleigh). Phys. Fluids, 10: 711-18(Apr. 1967).**

The stability of a weakly ionized plasma column against a screw-type perturbation in the presence of an applied axial electric field and a predominantly radial magnetic field—a linear Hall current accelerator—is investigated. The analysis is based on the ion and electron conservation equations and takes into consideration the effects of ionization. It is shown that the observed instability cannot be explained when the axial component of the magnetic field is identically zero even when one takes into consideration steady-state solutions with both radial and axial dependence. On the other hand, when the axial component of the magnetic field is small, but not zero, the column is unstable in the absence of an axial density gradient to a right-handed helical perturbation ($m = -1$). The resulting instability, which is of the Kadomtsev and Nedospasov type, is analyzed using a normal mode analysis. The results are in qualitative agreement with experiment. (auth)

27221 RECOMBINATION INSTABILITY. **D'Angelo, N. (Atomic Energy Commission Research Establishment, Risoe, Denmark). Phys. Fluids, 10: 719-23(Apr. 1967).**

A recombination instability is considered which may arise in a plasma if the temperature dependence of the volume recombination coefficient, α, is sufficiently strong. Two cases are analyzed: (a) a steady-state plasma produced in a neutral gas by x rays or high-energy electrons; and (b) an afterglow plasma. (auth)

27222 KILOCYCLE OSCILLATIONS IN AN ELECTRONEGATIVE PLASMA. **Gray, Eoin W.; Brown, J. M.; Emeleus, K. G. (Queen's Univ., Belfast). Int. J. Electron., 21: 577-82 (Dec. 1966).**

Observations were made of oscillations in the 100-kc region occurring in cold-cathode dc iodine vapor discharges at a pressure of approximately 0.2 torr. Variations of intensity and frequency with electrode separation and tube current were obtained, and variations of intensity with radial position in the positive column. The intensity of the oscillations showed considerable correlation with the occurrence of small protuberances at the edge of the cathode glow; suggestions are made about the nature of the oscillations in the main discharge which the protuberances appear to generate, but no definite conclusions were reached. (auth)

Shielding

Refer also to abstracts 26077 and 27479.

27223 (BNWL-236(Suppl.1)) ISOSHLD-II: CODE REVISION TO INCLUDE CALCULATION OF DOSE RATE FROM SHIELDED BREMSSTRAHLUNG SOURCES. **Simmons, G. L.; Regimbal, J. J.; Greenborg, J.; Kelly, E. L. Jr.; Van Tuyl, H. H. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar. 1967. Contract AT(45-1)-1830. 41p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.**

The ISOSHLD-II shielding code is principally intended for use in calculating the radiation dose, at a field point, from bremsstrahlung and/or decay gamma rays emitted by radioisotope sources. This program, with the newly added bremsstrahlung mode, is an extension of an earlier version (ISOSHLD). Five shield regions can be handled with up to twenty materials per shield; the source is considered to be the first shield region, i.e., bremsstrahlung and decay gamma rays are produced only in the source. Point kernel integration (over the source region) is used to calculate the radiation dose at a field point. Data needed to calculate fission-product isotopic concentrations, source spectrum distributions, and attenuation coefficients are contained in libraries used by the code. Problem input data are thereby minimized; the information required specifies the source–shield configuration and identifies the relevant materials and their densities. (auth)

27224 (JUL-435-ST) MESSUNG VON FLUSSDICHTE- UND DOSISLEISTUNGS-BESEITIGUNGSQUERSCHNITTEN VERSCHIEDENER ABSCHIRMMATERIALIEN FUER NEUTRONEN. **(Measurement of Flux Density and Dose Rate Removal Cross Sections of Various Shielding Materials for Neutrons). Nachtigall, D.; Heinzelmann, M. (Kernforschungsanlage, Juelich (West Germany). Zentralabteilung Strahlenschutz). Dec. 1966. 23p. (In German). Dep.**

The attenuation of neutrons is investigated for different materials. The removal cross sections and the buildup factors for the neutron flux density and the dose rate equivalent for neutron energies from 0.03 to 4.5 MeV were measured. Flux density and dose-rate equivalent are measured independently from thermal neutron energy to the maximum energy. Measurements are made with radioactive neutron sources and at the reactor. The results of the long counter and of the dosimeter of Andersson and Braun were compared with the results of a scintillation counter with five different polyethylene spheres. (auth)

27225 (ORNL-tr-1527) CALCULATION OF GAMMA-RADIATION BUILDUP FACTORS IN LAYERED SHIELDS. Schubart, H. Translated for Oak Ridge National Lab., Tenn., from report ABS-THH-1025. 25p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. JCL $2.60 fs, $0.95 mf.

Buildup factors have been previously determined experimentally, as well as by calculation, for important shielding materials but are limited to homogeneous materials and thicknesses of less than 20 mfp. The method for the approximate calculation of buildup factors in multilayered material configurations is discussed. Precise calculations, the approximation equation of Broder, and the approximation of Kitazume with modifications are included. The empirical coefficients α and β are determined and the results are given. A computer program for the approximate calculation of the buildup factor in layered shields is given. (M.H.R.)

27226 (ORNL-tr-1528) POSSIBILITIES OF APPLICATION OF ION ACCELERATORS IN SHIELDING EXPERIMENTS. Schultz, H. (Technische Hochschule, Hanover (West Germany)). Translated for Oak Ridge National Lab., Tenn., from report ABS-THH-1031. 36p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. JCL $3.60 fs, $1.28 mf.

Neutron production by nuclear collisions of accelerated ions is examined as a method for use in attenuation measurements of monoenergetic primary neutrons and in time-of-flight measurements on secondary neutrons. Calibration measurements are also discussed. Requirements for the necessary accelerator are listed. (D.L.C.)

27227 (ORNL-tr-1529) TABLES OF SHIELDING CONSTANTS FOR THE COMPONENTS OF TYPICAL SHIELDING MATERIALS. Sasse, S. (Technische Hochschule, Hanover (West Germany)). Translated for Oak Ridge National Lab., Tenn., from report ABS-THH-1027. 62p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. JCL $6.60 fs, $2.06 mf.

The tabular compilation was prepared for a study of the influence of the ratios of a mixture of components in a radiation shield on the weight of a shield. The method for the calculation of the constants is described. Tables are included on oxides and other compounds; minerals; nonminerals, rocks, and earths; iron, iron compounds, and slags; synthetic products and cements; and miscellaneous. (M.H.R.)

27228 (ORNL-tr-1534) ASPECTS OF AN EXPERIMENT FOR THE INVESTIGATION OF THE PHOTOPRODUCTION OF HIGHLY INTERACTING PARTICLES WITH ABSORPTION OF 5-6 GeV BREMSSTRAHLUNG IN A THICK TARGET. Heinze, K. (Technische Hochschule, Hanover (West Germany)). Translated for Oak Ridge National Lab., Tenn., from report ABS-THH-1030. 12p. Dep. CFSTI. JCL $1.60 fs, $0.80 mf.

An experiment was performed with 5 to 6 GeV incident bremsstrahlung on thick copper and lead targets to study the production of highly interacting particles such as neutrons, protons, and pions. A brief discussion of the expected results is presented. (M.O.W.)

27229 THE PRESENT STATE AND THE PROBLEMS OF SHIELDING STUDIES IN JAPAN. Tanaka, Yoshihisa (Kawasaki Dockyard Co., Ltd., Japan). Genshiryoku Kogyo, 12: No. 9, 33-7; 47(Aug. 1966). (In Japanese).

The main shielding studies in Japan are: multilayer penetration of neutrons and backscattering of gamma rays; multi-layer penetration of neutrons; duct streaming; and effect of irregularly shaped bodies. Contributing to this advancement in shielding studies are the use of large computers and the availability of LT and SPR as shielding research tools. Shielding studies as part of neutron physics, those as part of reactor design, and problems in the organization of shielding studies are first described; then the status of each of the above four types of study is presented; and finally, problems are pointed out. (TSS)

27230 DEUTERON BINDING ENERGY AND ENERGY LOSS BY GAMMA RAYS IN WATER FROM COMPTON SCATTERING. Chi, Benjamin E.; Robinson, Berol L. (Western Reserve Univ., Cleveland). Nucl. Phys., A98: 625-6(1967).

In attempting to understand the low value for the binding energy of the deuteron obtained by Mohahan, Raboy, and Trail using a scintillation spectrometer, an experiment was performed to determine the effect of Compton scattering by water of gamma rays from a distributed source closely simulating the source of capture gamma rays. The correction obtained in this way was identical to that obtained in the original work for Compton scattering by water of the radiation from a point source. (auth)

27231 ANALYTICAL SOLUTION OF THE MULTILAYER PROBLEM IN THE BUILDUP CALCULATION. Zumach, W. (MAN, Augsburg). Atomkernenergie, 12: 20-4(Jan.-Feb. 1967). (In German).

The buildup factors for the calculation of gamma doses behind a thick layer are well known for any interesting shielding material and are given as curves, tables or in analytical form. In the case of homogeneous media certain assumptions have to be made, such as plane geometry, parallel beam, infinite dimensions etc., but no serious difficulties have to be overcome in calculating. In the case of a multiple-layer shield consisting of different materials in mixed order some recommendations are known which will permit a rough approximation. Recently some recent programs have become known, based either on Monte Carlo methods or on double P_n approximations to give the angle—energy distributions. For optimum shielding purposes analytical solutions of the problem are still of interest in respect to the variational calculus treatment. Some new approximations are developed and also an "exact" analytical solution of the multilayer problem is presented. The "method of analytic continuation" connects the different material buildups using two boundary conditions: the continuity of dose (left border) and the transition of the "true" buildup to the material buildup in the case of very large thickness (right border). Realizing the buildup in any layer to be partly originated in the foregoing layer, a simple mode of "continuation" is obtained. A little more complicated version of the continuation method regards the buildup in any region to be composed of two or more buildups of the foregoing regions. Applying these boundary conditions ϵ values are calculated which will weight the material buildups of the different slabs. Provided buildup and energy spectrum are analytical functions, an "exact" solution in plane geometry is achieved in two different ways. A "differential dose" in an energy interval $[E,E + dE]$ of the spectrum $S(E)$ is said to be originated by a monoenergetic point source of energy E. It produces an energy spectrum in a certain distance, also a "differential buildup" $P(E,z)$. By integrating the primary spectrum the total energy distribution in that point is obtained. Corrections to angular distributions are possible for applying this method to a single medium, say water. So the analytical solution is an exact one in the meaning that its error is originated only by the presumed functions error. (auth)

Solid-State Physics

Refer also to abstracts 27142 and 27503.

27232 (N-67-11810) THEORETICAL INVESTIGATION OF ULTRASONIC ATTENUATION FOR FREE ELECTRONS IN THE PRESENCE OF A MAGNETIC FIELD. Flax, Lawrence (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Nov. 1966. 35p. (NASA-TN-D-3723). CFSTI $3.00 cy, $0.65 mn.

The ultrasonic attenuation theory developed by Cohen, Harrison, and Harrison is reevaluated to include all ql values, where q is the phonon wave number and l the electron mean free path. This theory predicts a shift in the extrema as a function of magnetic field, which has recently been observed experimentally. The theory also describes correctly the limiting cases of magnetic field intensity approaching zero and infinity. Tables and graphs are presented for the relative attenuation of transverse and longitudinal waves in the presence of a magnetic field for various ql values. (auth)

27233 PARAMAGNETIC RESONANCE OF IRRADIATED LITHIUM HYDRIDE LUMINESCENT CRYSTALS. Shul'gin, B. V.; Gavrilov, F. F.; Dvinyaninov, B. L.; Koryakov, V. I.; Chirkov, A. K. (Ural Polytechnic Inst., Sverdlovsk, USSR). Izv. Vyssh. Ucheb. Zaved., Fiz., No. 1, 69-73(1967). (In Russian).

The dependence of the intensity and width of the absorption line of the EPR on temperature was investigated in irradiated lithium hydride luminescent crystals. The irradiation was done at room temperature with the unfiltered light of an SVD-120 mercury lamp and betatron electrons with energies of 8 to 10 MeV. The temperature dependence of the intensity and width of the EPR absorption line of LiH crystals with blue luminescence undergoes a sharp change in the temperature range from 90 to 120°C. The first maximum on the thermoluminescence curve is also observed in this range. This coincidence occurs because the centers of the electron capture in LiH responsible for the first thermoluminescence peak are bound with the colloidal lithium. The release of electrons from the capture level corresponding to the first thermoluminescence peak causes the elimination of these absorption centers. As a result, the intensity of the paramagnetic absorption line decreases and the width increases because of the absorption by the color centers. (ATD)

27234 EFFECT OF X RADIATION ON THE ELECTROPHYSICAL PROPERTIES OF GERMANIUM AND GERMANIUM p–n JUNCTIONS. **Krivov, M. A.; Malyanov, S. V.; Gaman, V. I. (Siberian Physical-Technical Inst., Tomsk, USSR). Ivz. Vyssh. Ucheb. Zaved., Fiz., No. 1, 99-104(1967). (In Russian).**

An investigation was made of the rules according to which variations occur in the reverse branch of the current–voltage characteristics of germanium diodes subjected to x radiation. D7Zh- and D1602V-type diodes and emitter-base and collector-base p–n junctions in germanium industrial P40A-type triodes were used in the investigation. Resistivity of the bases was 20 to 25 ohm cm for diodes and 7 to 10 ohm cm for triodes. Irradiation was conducted at 0°C and at room temperature with the RUP-200 x-ray installation. For all investigated p–n junctions the dependence of reverse current on the voltage before irradiation can be expressed by the following relationship $I_{0\,rev} = AV_{rev}^{n}$ (1), where A and n are constants (n is unity or less). Under the effect of x rays, the reverse current through the p–n junction does not follow (1). During irradiation with x rays, the reverse current can be expressed as $I_{rev} = B\exp(cV_{rev})$ (2), where B and c are constants for a given specimen and $\beta = \frac{1}{4}$ at voltages up to 15 to 20 V and $\beta = \frac{1}{2}$ at voltages above 20 V. It can be assumed that the relationships observed during irradiation also depend on the Frenkel effect. In addition to the ionization process, excitation of atoms also occurs with the absorption of x radiation. Thermal ionization of excited atoms then takes place, first in the region of the space charge of the p–n junction and then at high voltages outside the p–n junction. This mechanism leads to an increased concentration of free current carriers and to the dependence of the reverse current on voltage according to (2). After cessation of x irradiation of germanium p–n junctions, a long-duration decrease in the photoelectric current increment takes place. The complete restoration of the reverse branch takes place several hours after irradiation has ceased. (ATD)

27235 PHASE TRANSITIONS IN GAMMA-RAY IRRADIATED KNO_3. **Gesi, Kazuo (Japan Atomic Energy Research Inst., Tokyo). Jap. J. Appl. Phys., 6: 781(June 1967).**

Several c plates of KNO_3, cut from a single crystal prepared by slow cooling of aqueous solution, were exposed with gamma rays from a 16,000-Ci ^{60}Co source at room temperatures. The dose rate was 1.52×10^6 R/hr. Diagrams showing the phase transitions are described. (M.O.W.)

27236 NATURE OF RADIOELECTRET EFFECT IN PARAFFIN WAX. **Gomulkiewicz, J. (Higher Agricultural Coll., Wroclaw). Acta Phys. Pol., 31: 575-80(Mar. 1967).**

Based on the assumption that the radioelectret effect in paraffin wax is due to electrons confined in traps a theoretical model for the phenomena responsible for the production of free electrons and their confinement in traps has been proposed. The relations predicted by the model are in good agreement with experimental results. (auth)

27237 SPATIAL DISTRIBUTION OF EXCESS CARRIERS IN ELECTRON-BEAM EXCITED SEMICONDUCTORS. Kyser, David F.; Wittry, David B. (Univ. of Southern California, Los Angeles). Proc. IEEE (Inst. Elec. Electron. Eng.), 55: 733-4 (May 1967).

The steady-state one-dimensional carrier distribution in depth is computed for electron-beam excitation of semiconductors, including diffusion and surface recombination. An example is given for n-type GaAs bombarded by a 29-kV electron beam. (auth)

27238 KINETICS OF THE ACCUMULATION OF HOLE COLOR CENTERS IN ALKALI-HALIDE CRYSTALS DOPED WITH ALKALINE-EARTH METALS. **Lisitsyn, V. M. Opt. Spectros. (USSR) (Engl. Transl.), 22: 43-4(Jan. 1967).**

Translated from Opt. Spektros., 22: 86-9(Jan. 1967).

The kinetics of accumulation of V_2 and V_3 centers at room temperature was investigated for KCl, KBr, and NaCl crystals doped with alkaline earths and irradiated with protons. It has been shown that an intense V_2 band is formed in KCl and KBr crystals while a V_3 band is formed in NaCl. The results confirm the hypothesis that anion vacancies can be generated by displacement of a halide into a cation vacancy. (auth)

27239 EFFECT OF SHALLOW TRAPPING LEVELS ON X-RAY LUMINESCENCE PROPERTIES OF SODIUM IODIDE. **Lyskovich, A. B.; Chornii, Z. P. Opt. Spectros. (USSR) (Engl. Transl.), 22: 49-52(Jan. 1967).**

Translated from Opt. Spektros., 22: 96-102(Jan. 1967).

The results of investigations of the x-ray luminescence properties of sodium iodide crystals are investigated. It is assumed that electron and hole traps play a fundamental role in the processes which were investigated and that they are responsible for the temperature and concentrational dependence of the x-ray luminescence spectrum, for its dependence on the density of excitation and ir stimulation, and for the thermal behavior of individual radioluminescence bands. (auth)

27240 HYPERFINE INTERACTION FIELDS FOR HEAVY ELEMENTS DISSOLVED IN IRON. **Kogan, A. V.; Kul'kov, V. D.; Nikitin, L. P. (Ioffe Inst. of Physics and Tech., Leningrad). Soviet Phys.-Solid State (Engl. Transl.), 8: 2843-5(June 1967).**

Translated from Fiz. Tver. Tela, 8: 3555-8(Dec. 1966).

The internal field H_{eff} at lutetium nuclei in alloys with iron is measured from the γ-ray anisotropy of radioactive ^{177}Lu. It is shown that it does not exceed 70 kOe. Data are given on the internal fields of elements from Lu to Au in an iron matrix. It is shown that the observed dependence of H_{eff} on the atomic number cannot be described with sufficient reliability on the basis of existing theories. (auth)

27241 METHODS FOR THE DETERMINATION OF THE ISOTOPE DIFFUSION EFFECT UNDER CONDITIONS OF ELECTROTRANSPORT IN A SOLID BODY. **Naumov, A. N.; Ptashnik, V. B. (Ioffe Inst. of Physics and Tech., Leningrad). Soviet Phys.-Solid State (Engl. Transl.), 8: 2869-71(June 1967).**

Translated from Fiz. Tver. Tela, 8: 3590-4(Dec. 1966).

Graphical and approximate analytical methods are considered for the determination of the isotope diffusion effect in the case of electro-transport in a solid. Equations are derived relating the experimentally measurable separation factor of isotopes and the magnitude of the ratio of diffusion coefficients of isotopes. (auth)

27242 CHANGES IN THE ELECTRICAL PROPERTIES OF FLUORITE CAUSED BY IRRADIATION. **Golubeva, L. A.; Nikitinskaya, T. I. (Kalinin Polytechnic Inst., Leningrad). Soviet Phys.-Solid State (Engl. Transl.), 8: 2908-9(June 1967).**

Translated from Fiz. Tverd. Tela, 8: 3641-3(Dec. 1966).

A qualitative comparison of the electric properties of pure and oxygen-containing fluorite crystals before and after x irradiation is made. The frequency dependence and the temperature dependence of the tangent of the dielectric loss angle (tan δ) were measured. Comparison of the results with calculations based on electric conductivity lead to the conclusion that the losses in oxygen-containing crystals are mainly ohmic in nature above about 330°K. The conduction losses can be decreased by irradiation in quantitative agreement with the decrease in the conductivity itself. At somewhat higher temperatures the losses in pure crystals also have an ohmic character. Irradiation of the pure crystals also leads to a decrease in tan δ. (A.G.W.)

27243 MODULATION OF THE LIGHT REFLECTED BY SILICON p–n JUNCTIONS IRRADIATED WITH FAST NEUTRONS. **Volod'ko, L. V.; Lappo, M. T.; Lomako, V. M.; Tkachev, V. D. (Lenin Belorussian State Univ., Minsk). Soviet Phys.-Solid State (Engl. Transl.), 8: 2952-3(June 1967).**

Translated from Fiz. Tverd. Tela, 8: 3683-4(Dec. 1966).

Modulated reflection of light by unirradiated Si p–n junctions observed over the spectral range 0.8 to 2.5 μ had no structure. After doses of fast neutrons from 10^{15} to 10^{18} neutrons/cm^2, the modulated reflection spectrum exhibited a well-defined structure. The form of the spectrum depended on the radiation dose and subsequent heat treatment. A direct relationship between the observed maxima and the radiation defects generated by neutron bombardment and processes of defect rearrangement during annealing was indicated. (A.G.W.)

27244 ENERGY SPECTRUM OF SECONDARY ELECTRONS FROM BARIUM OXIDE ADSORBED ON TUNGSTEN IN THE CASE OF LOW PRIMARY ELECTRON ENERGIES. **Shul'man, A. R.; Bazhanova, N. P. (Kalinin Polytechnic Inst., Leningrad). Soviet Phys.-Solid State (Engl. Transl.), 8: 2964-6(June 1967).**

Translated from Fiz. Tverd. Tela, 8: 3695-7(Dec. 1966).

Changes occurring in the energy spectrum of secondary electrons during the adsorption of BaO on W are reported. The primary electron energy was ~30 eV. Results indicated that when the film thickness was less than one monolayer the main effect of the BaO film was to reduce the work function of W. A second maximum in the curve indicating the onset of the participation of the film itself in the formation of secondary electrons began to appear between 0.5 and 1 monolayer. When the film thickness reached 6 monolayers, the BaO film predominated in the emission, and at 15 monolayers the whole emission was from the film. (A.G.W.)

27245 LOCAL COMPOSITIONAL CHANGES IN ALKALI SILICATE GLASSES DURING ELECTRON MICROPROBE ANALYSIS. **Borom, M. P.; Hanneman, R. E. (General Electric Co., Schenectady, N. Y.). J. Appl. Phys., 38: 2406-7(Apr. 1967).**

Two types of local compositional drifts caused by the effects of electron beams were observed in microprobe work on a variety of alkali silicate glasses. In the first type the silicon x-ray intensity increases with time while the alkali metal x-ray intensity decreases with time. In the second type a cratering effect is observed at the point of contact of the electron beam. It is suggested that the cratering effect is due primarily to thermal effects, including surface diffusion and vaporization, caused by local beam heating and that the local compositional drift is directly related to the cratering process. Methods of minimizing the problem are considered briefly. (A.G.W.)

27246 HIGH POTENTIALS IN ELECTRON-IRRADIATED DIELECTRICS. **Gross, Bernhard (International Atomic Energy Agency, Vienna); Nablo, Sam V. J. Appl. Phys., 38: 2272-5(Apr. 1967).**

Bombardment of high-resistivity solid dielectrics with energetic electrons leads to electron trapping and space-charge buildup. The space-charge field in the dielectric can become high enough to reduce significantly the range of the incident electrons. A simple mathematical model gives a semiquantitative picture of the effect. It confirms previous suggestions that the potential in the dielectric might exceed the accelerating potential of the electrons. (auth)

27247 PREPARATION OF HOMOGENEOUS n-TYPE InSb BY THERMAL-NEUTRON IRRADIATION. Clark, W. Gilbert; Isaacson, R. A. (Univ. of California, San Diego, La Jolla). J. Appl. Phys., 38: 2284-9(Apr. 1967).

Thermal-neutron irradiation of high-purity (uncompensated, $n = 4 \times 10^{13}$ cm^{-3}) InSb at ambient temperature has been employed to produce n-type material with $n = 10^{14}$ to 10^{17} cm^{-3}. The transmutation end products are 98% Sn and 2% Te, both donors. A detailed prescription for producing samples with an accurate control of doping concentration (~7%), a mobility (μ) at 77°K that is 80 to 100% of the highest obtained by other methods, and high homogeneity, is given. Although the reported homogeneity is about 2%, the method is, in principle, capable of much greater homogeneity. A contribution to the nuclear spin-lattice relaxation rate ($1/T_1$) caused by radiation damage is identified. The changes in n, μ, $1/T_1$, and homogeneity caused by annealing at temperatures up to 450°C are also presented. (auth)

27248 INFRARED ABSORPTION OF THE GAMMA-INDUCED SURFACE LAYER ON GERMANIUM. **Lin, K. C.; Lee, L. (Union Industrial Research Inst., Hsinchu, Taiwan). J. Appl. Phys., 38: 2097-8(Apr. 1967).**

A thin layer on the surface of single-crystal germanium produced by ^{60}Co gamma irradiation has been found. This layer can only be produced on specimens irradiated in air. Several infrared absorption bands with peak absorptions at 3, 6, 6.85, 11.5, and 12.7 μ are associated with the layer. Of these bands, only the 11.5-μ band has been identified as resulting from germanium dioxide formed on the surface by chemical reaction of germanium with oxygen and/or ozone. The origins of other bands as well as the layer remain unknown. (auth)

27249 THERMOLUMINESCENCE AND COLOR CENTERS IN LiF. **Christy, R. W.; Johnson, N. M.; Wilbarg, R. R. (Dartmouth Coll., Hanover, N. H.). J. Appl. Phys., 38: 2099-2106 (Apr. 1967).**

Thermoluminescence emission above room temperature and optical absorption have been studied in LiF crystals irradiated by gamma rays, with emphasis on conditions of greatest interest for applications to radiation dosimetry. The specimens were Harshaw crystals of differing purity, and the purpose was to correlate the electron and hole traps and recombination centers involved in the thermoluminescence with optical-absorption bands produced by the trapped carriers. The dominant glow peak in suitably treated crystals occurs at about 200°C, and this is correlated with an absorption band at 310 mμ, through thermal and optical bleaching of the thermoluminescence and optical absorption. A smaller glow peak at 100°C is correlated with an absorption band at 380 mμ. The F center absorbing at 250 mμ appears to be the electron trap associated with both glow peaks. It is concluded that the 310- and 380-mμ centers are trapped-hole centers, and the thermoluminescence occurs after they are thermally ionized. The recombination center that produces the visible-light emission is believed to be not the F center, however, but an impurity center that absorbs at 196 mμ. An energy-level diagram is suggested, which can account for the observed optical and thermal transitions. It depends on electron tunneling from the F center to the 196-mμ center. Available evidence indicates that the 310- and 380-mμ centers involve Mg; the impurity responsible for the 196-mμ center may be Al. (auth)

27250 DISSOLUTION SPIRALS ON GAMMA-IRRADIATED LITHIUM FLUORIDE. **Ives, M. B.; Ramachandran, T. R. (McMaster Univ., Hamilton, Ont.). J. Appl. Phys., 38: 2121-3 (Apr. 1967).**

Double-spiral features have been observed at high resolution on lithium fluoride {100} surfaces etched in distilled water containing from 0.1 to 9 ppM ferric ions. The models proposed for similar features on other materials are reviewed, and suggestions are made regarding the lattice-defect configurations responsible for the spirals. Radiation-induced climb of segments of dislocations parallel to the surface is introduced as a possibility. (auth)

27251 INFLUENCE OF CHANNELLING ON RADIATION DAMAGE PRODUCED IN SILICON DURING ION BOMBARDMENT. **Nelson, R. S.; Mazey, D. J. (Atomic Energy Research Establishment, Harwell, Eng.). J. Mater. Sci., 2: 211-16(May 1967). (AERE-R-5394).**

The ion bombardment of silicon results in the formation of an amorphous phase in the vicinity of the bombarded regions. This gives rise to a milky appearance which is easily distinguishable from an adjacent unbombarded region. An experiment is described which was specifically designed to study the influence of channelling of incident 80-keV Ne$^+$ ions on the formation of this amorphous phase. It was found that channelling significantly reduces the rate at which this phase is produced, and in the particular case of the ⟨110⟩ axial channel this corresponds to a reduction in radiation damage by a factor of about 8. The results are compared with the current theories of channelling and are found to be in reasonable quantitative agreement. (auth)

27252 COLOR CENTERS OF RHOMBIC AND MONOCLINIC SYMMETRIES IN NaF. **Johannson, G.; Lanzl, F.; von der Osten, W.; Waidelich, W. (Technische Hochschule, Darmstadt, Ger.). Z. Phys., 201: 430-44(1967). (In German).**

A number of zero-phonon absorption lines of F aggregate color centers were studied in x-irradiated NaF crystals under uniaxial stress. The color centers associated with the lines were found to exhibit rhombic (D_{2h}, D_2, C_{2v}; rotation axes along ⟨110⟩ and ⟨100⟩) and monoclinic (C_{2h}, C_2, C_s; rotation axis along ⟨110⟩) symmetries. The transitions of the rhombic color centers correspond to ⟨100⟩ and ⟨110⟩ dipoles, those of the monoclinic centers to ⟨112⟩ and ⟨110⟩ dipoles. The most prominent line at 5803 Å is due to a ⟨112⟩ dipole transition within a monoclinic color center. Several models of centers are discussed. (auth)

27253 MOESSBAUER EFFECT STUDY OF FERROMAGNETISM AND FERROMAGNETIC RELAXATION IN $ErAl_2$. **Wiedemann, W.; Zinn, W. (Kommission fuer Tieftemperaturforschung, Munich. Siemens-Schuckertwerke A. G., Munich). Phys. Lett., 24A: 506-8(May 8, 1967).**

Magnetic properties and spin relaxation times of Er^{3+} in ferromagnetic and paramagnetic $ErAl_2$ were deduced from the ^{166}Er Mössbauer spectra observed between 4 and 20°K. (auth)

27254 ANOMALOUS BEHAVIOUR OF THE KNIGHT SHIFT IN $SmAl_2$. **Buschow, K. H. J. (Philips Research Labs., Eindhoven, Netherlands); Van Diepen, A. M.; De Wijn, H. W. Phys. Lett., 24A: 536-7(May 8, 1967).**

The Knight Shift of the ^{27}Al NMR in the intermetallic compound $SmAl_2$ was measured as a function of the temperature and found to be incompatible with theories developed up to the present. (auth)

27255 ELASTIC FORM FACTOR FOR A HINDERED ROTATOR. **Solt, G.; Kota, J. (Central Physics Research Inst., Budapest). Phys. Lett., 24A: 542-3(May 8, 1967).**

Neutron-scattering intensity for an NH_4^+ ion performing uniaxial rotation is calculated. Comparison with experimental data suggests that this model can be used as a first approximation to describe proton dynamics in NH_4I at room temperatures. (auth)

27256 LOCAL MODES IN Li–Mg AND Be–Cu ALLOYS. **Natkaniec, I.; Parlinski, K.; Bajorek, A.; Sudnik-Hrynkiewicz, M. (Joint Inst. for Nuclear Research, Dubna, USSR. Inst. of Nuclear Physics, Krakow). Phys. Lett., 24A: 517-19(May 8, 1967).**

Inelastic neutron scattering experiments with the alloys $Li_{0.05}Mg_{0.95}$, $Li_{0.10}Mg_{0.90}$, $Be_{0.02}Cu_{0.98}$, and $Be_{0.05}Cu_{0.95}$ and the pure metals, magnesium and copper, revealed vibrations of the impurity lithium atoms in the magnesium lattice of an energy of 35 ± 2 MeV, and the beryllium atoms in the copper lattice of an energy of 42 ± 2 MeV. The energy of these local modes for these systems, calculated with the assumption that the force constants in the vicinity of the impurity atom remain unchanged, equals 43 MeV for Li–Mg and about 58 MeV for Be–Cu, respectively. It was estimated on the basis of the measured energies of local modes that the average change of the force constants of the impurity atom is about 45% for Li–Mg and 56% for Be–Cu. (auth)

Theoretical Physics

27257 (NP-16739) SOME NEW SOLUTIONS OF THE GRAVITATIONAL FIELD EQUATIONS. **Kuchowicz, Bronislaw (Warsaw Univ. (Poland). Dept. of Radiochemistry). Nov. 1966. 20p. Dep.**

Few explicit solutions of Einstein's gravitational equations for radially symmetric distributions of matter are known. Usually, for a given $e^{-\lambda}$, one obtains a second order differential equation from which e^{ν} should be determined; the latter equation is not always integrable in terms of known functions. In this paper it is proposed that the function $e^{-\lambda}$ satisfies some first order differential equation related in a certain way to the differential equation for e^{ν}. Some types of the proposed equations are examined and several new explicit solutions of Einstein's field equations in space filled with matter are found. The procedure outlined permits also further solutions. (auth)

27258 ASYMPTOTIC BEHAVIOR OF GREEN'S FUNCTIONS IN VISCOUS HYDRODYNAMIC APPROXIMATION IN THE CASE OF STATISTICAL MECHANICS OF QUANTUM SYSTEMS. Sadovnikov, B. I. (Inst. of Mathematics, Moscow). Dokl. Akad. Nauk SSSR, 169: 66-9(July 1, 1966). (In Russian).

An asymptotic expression for the classical Green's function Fourier component in viscous hydrodynamic approximation was constructed previously (Dokl. Akad. Nauk SSSR, 164: 71(1965)). An attempt is made of expanding the expression for the case of quantum statistical mechanics using the quantum mechanical analog of the Boltzmann equation. (R.V.J.)

27259 SOME REMARKS ON THE RELATION BETWEEN MASS AND ENERGY. Gherman, Oliviu. Stud. Univ. Babes-Bolyai, Ser. Math.-Phys., 11: No. 2, 101-5(1966).

A brief discussion is presented on the relation of mass and energy. It is proposed to characterize the quantity of matter by the energy-momentum four-vector. (W.D.M.)

27260 REVERSE PROBLEM OF THE RELATIVISTIC MOVEMENT IN THE CASE OF VARIABLE MASS POINT. Stan, Ioan; Toth, Alexandru. Stud. Univ. Babes-Bolyai, Ser. Math.-Phys., 11: No. 2, 107-13(1966). (In Rumanian).

The reverse problem of the movement of a relativistic variable mass point was investigated. Starting from the simultaneous adjustment and separation of some elementary masses, the general law of the mass variation is deduced both as against the fixed system and the mobile one, after which there are calculated some particular, classic, and relativistic cases. (auth)

27261 THEORY OF THE MOTION OF CHARGED PARTICLES IN DIRECTION-CONSTANT TIME-DEPENDENT MAGNETIC FIELDS AND ELECTRICAL SUPPLEMENTARY FIELDS. Koch, Eckhard (Arbeitsstelle fuer Statistiche Physik, Leipzig. Deutsche Akademie der Wissenschaften, Berlin). Beitr. Plasmaphys., 6: 431-49(1966). (In German).

The motion of a charged particle in spatially homogeneous electric and magnetic fields is calculated for the case of the magnetic field to have a constant direction and its intensity to vary with an arbitrary power of time. The special case of a linearly increasing magnetic field is treated in detail taking into account a friction force proportional to the particle velocity. Generally, the equations of motion are reduced to a single differential equation of second order which is integrated exactly. The higher transcendental functions appearing in the solution are then approximated by elementary functions. Thus asymptotic approximative equations of a very simple form are obtained for position, velocity, kinetic energy, and magnetic moment of the particle. The dependence of the particle orbit on the initial values of position and velocity and on the properties of the magnetic field is studied, and it is shown, how the particle motion is a helical motion superposed by a drift. The influence of the electric field induced by the time dependent magnetic field on the particle motion is considered in detail. For an additional electric field being present a drift formula is derived which is a generalization of the well-known E × B drift for constant fields. (auth)

27262 DETECTION TRAJECTORIES OF CHARGED PARTICLES MOVING IN A CORONA DISCHARGE FIELD. Palkin, L. N. Izv. Akad. Nauk SSSR, Energ. Transp., No. 1, 63-6(Jan.-Feb. 1967). (In Russian).

The inertia of charged particle motion in a corona discharge field was studied and a graphical—analytical method was developed for particle trajectories. (R.V.J.)

27263 STABILITY OF MATTER. I. Dyson, Freeman J.; Lenard A. (Inst. for Advanced Study, Princeton, N. J.). J. Math. Phys. (N. Y.), 8: 423-34(Mar. 1967).

The stability problem of a system of charged point particles is discussed, and a number of relevant theorems are proven. The total energy of a system of N particles has a negative lower bound proportional to $N^{5/3}$ when no assumption is made on the statistics of the particles. When all particles belong to a fixed number of fermion species, a lower bound exists proportional to N. (auth)

27264 EQUATIONS OF MOTION IN CLASSICAL NONLINEAR FIELD THEORIES. Rosen, Gerald (Drexel Inst. of Tech., Philadelphia). J. Math. Phys. (N. Y.), 8: 573-5(Mar. 1967).

A Rayleigh—Ritz procedure is outlined for deriving approximate equations of "particle" motion (the over-all motion of a singularity-free particlelike solution) in a superimposed small-amplitude external field. The method is illustrated here for a classical nonlinear model scalar field theory. A relativistic generalization of the approximation procedure is described. (auth)

27265 THE POST-NEWTONIAN EFFECTS OF GENERAL RELATIVITY ON THE EQUILIBRIUM OF UNIFORMLY ROTATING BODIES. III. THE DEFORMED FIGURES OF THE JACOBI ELLIPSOIDS. Chandrasekhar, S. (Univ. of Chicago). Astrophys. J., 148: 621-44(May 1967).

The effects of general relativity, in the post-Newtonian approximation, on the Jacobian figures of equilibrium of uniformly rotating homogeneous masses are determined. It is shown, for example, that the post-Newtonian figure is obtained by a deformation of the Jacobi ellipsoid by a suitable Lagrangian displacement cubic in the coordinates. The solution of the post-Newtonian equations exhibits an indeterminacy at the point of bifurcation M_2, where the Jacobian sequence branches off from the Maclaurin sequence, and a singularity at a point J_4, where the axes of the Jacobi ellipsoid are in the ratios $1:0.2972:0.2575$. The indeterminacy in the solution at M_2 arises from the fact that at this point the Maclaurin spheroid is neutral to an infinitesimal deformation proportional to $(x_1, -x_2, 0)$; and the singularity at J_4 arises from the fact that at this point the Jacobi ellipsoid is unstable to the deformation induced by the effects of general relativity. (auth)

27266 APPEARANCE OF A ROTATING CONFIGURATION AS VIEWED FROM INFINITY. Krefetz, Elliott (Univ. of Chicago). Astrophys. J., 148: 613-20(May 1967).

The appearance at infinity is examined for a mass distribution given in the post-Newtonian approximation. (auth)

27267 THE EQUILIBRIUM OF SLOWLY ROTATING CONFIGURATIONS IN THE POST-NEWTONIAN APPROXIMATION: CORRECTIONS TO CLAIRAUT'S EQUATION. Krefetz, Elliott (Univ. of Chicago). Astrophys. J., 148: 589-612(May 1967).

The post-Newtonian effects on the equilibrium of a slowly uniformly rotating fluid with symmetry about the axis of rotation and under stationary conditions are examined. The problem is formulated, successively, in terms of an effective potential, the equations of motion, and a variational principle. All three approaches yield the same generalization of Clairaut's equation. (auth)

27268 THE POST-NEWTONIAN EFFECTS OF GENERAL RELATIVITY ON THE EQUILIBRIUM OF UNIFORMLY ROTATING BODIES. IV. THE ROCHE MODEL. Chandrasekhar, S. (Univ. of Chicago). Astrophys. J., 148: 645-9(May 1967).

The Roche model, consisting of a tenuous envelope in the field of a central rigidly rotating central mass, is considered in the framework of the post-Newtonian equations of hydrodynamics; and the effect, in particular, on the critical isobaric surface with the lenticular shape is determined. (auth)

27269 GENERALIZED EIGENVALUE PROBLEMS. Schwartz, Charles (Univ. of California, Berkeley). Ann. Phys. (N. Y.), 42: 367-74(May 1967).

The equation $L(\lambda)\psi = 0$ is examined, where L is a linear operator of the usual sort, except that it is not necessarily self-adjoint, and its dependence on the eigenvalue parameter λ is not necessarily linear. Variational principles, normalization of eigenfunctions, resolution of the identity, and operator inversion are some of the aspects discussed. (auth)

27270 A SIMPLE DERIVATION OF THE SCHROEDINGER EQUATION FROM THE THEORY OF MARKOFF PROCESSES. De La Pena-Auerbach, L. (Univ. Nacional de Mexico, Mexico City). Phys. Lett., 24A: 603-4(May 22, 1967).

The Schroedinger equation is derived rather simply from the theory of Markoff processes, making a minimum of explicitly stated assumptions. (auth)

27271 CLASSIFICATION OF CURVATURE TENSOR. Misra, R. M. (Univ. of Gorakhpur, India). Amer. J. Phys., 35: 394-7 (May 1967).

A new method for classification of the gravitational field is presented. It is shown that this scheme leads to exactly the same types of gravitational fields as previously obtained by Petrov, Penrose, and Sachs, etc. Some physical applications are also given. (auth)

27272 RELATIVISTIC TRANSFORMATION OF THE ELECTROMAGNETIC FIELD. Beauregard, Laurent A. (Franklin Coll., Ind.). Amer. J. Phys., 35: 439(May 1967).

That the Lorentz force law (and therefore the existence of the magnetic field) is a logical consequence of Coulomb's law and the postulates of special relativity has been shown by Rosser (Contemp. Phys., 1: 453 (1960)). From this result the transformation of the electromagnetic field from one inertial frame to another is derived. (A.G.W.)

27273 INTERACTION OF THE GRAVITATIONAL AND SPINOR FIELDS. **Oliveira, Colber G.; Vidal, Alberto (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). An. Acad. Brasil. Cienc., 38: 27-34(Jan.-Mar. 1966).**

The interaction between spinor fields and gravitation is treated using the Hamiltonian formulation and a set of tetrads as the fundamental variables for the gravitational field. The coupled system is studied from the point of view of the three-dimensional geometry and under the condition that the gravitational field is a linear weak field; the transformation law for the spinor field is then interpreted as a gauge transformation in the three-dimensional hypersurface of constant time. (L.B.S.)

27274 DELAY POTENTIALS IN SPECIAL RELATIVITY. **Hoang, Pham Tan. Compt. Rend., Ser. A, 264: 158-60(Jan. 16, 1967). (In French).**

The formula is developed for delayed potentials using the formalism of special relativity. A continuous charge distribution along the flow lines, field trajectories of the universal force vector necessarily oriented in time, is considered in Minkowski space–time. (TSS)

27275 CHARGED PARTICLE PARAXIAL MOTION IN A CONSTANT SPATIALLY MODULATED MAGNETIC FIELD. **Kovtun, R. I. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh., 12: 559-63(Apr. 1967). (In Russian).**

Charged particle motion in a superposition of a strong uniform magnetic field and a relatively weak axially symmetric perturbation, periodically varying along the field symmetry axis, is investigated, using the Krylov-Bogolyubov asymptotic method for the solution of nonlinear equations. It is shown that if a particle passes one spatial period of the field modulation in a time which is approximately equal to the period of the particle cyclotron rotation, the particle velocity direction undergoes slow but rather appreciable changes, the period of which may under certain conditions tend to infinity. (auth)

27276 DIRAC'S HYPOTHESIS OF A VARIABLE GRAVITATIONAL "CONSTANT" AND EXPERIMENTAL FACTS. Jordan, Pascual (Hamburg Univ.). Cah. Phys., No. 194, 357-68(Oct. 1966).

It is suggested that if Dirac's hypothesis is really correct, then there must exist many details in the structure and the history of the earth, influenced by the decrease of gravitation. The effects of decreasing gravitation is discussed in terms of the expansion rifts, continents and ocean basins, formation of oceans, paleomagnetism, volcanic activity, interior of the earth, celestial mechanics, tidal friction, and paleoclimatology. (W.D.M.)

27277 CONTINUITY OF CAUSAL AUTOMORPHISMS OF SPACE-TIME. **Alonso, J. L.; Yndurain, F. J. (Univ. of Zaragoza, Spain). Commun. Math. Phys., 4: 349-51(Apr. 10, 1967).**

It is proven that any causal automorphism of the (curved or not) space–time in any dimension is continuous. (auth)

27278 NEW SOURCE FOR DYNAMICAL GRAVITATIONAL FIELDS. **Sinsky, J.; Weber, J. (Univ. of Maryland, College Park). Phys. Rev. Lett., 18: 795-7(May 8, 1967).**

A new source for dynamical gravitational fields consisting of an acoustically stressed volume of matter is described. The very-near-zone dynamical gravitational fields are measured as a function of distance and azimuthal angle, using apparatus responsive to the curvature tensor. The high frequency of 1660 cycles per second implies a new regime for gravitational technology. (auth)

27279 CELESTIAL MECHANICS AND DIRAC'S HYPOTHESIS. Jordan, P. (Univ., Hamburg). Z. Phys., 201: 394-5(1967). (In German).

As a case of correctness of Dirac's hypothesis, the concept of ephemeridic time remains definable. But this ephemeridic time scale then is not equal to the time coordinate of any inertial system. (auth)

27280 A THEORY OF ANOMALOUS GRAVITATIONAL INTERACTION. I. CASE OF THE BOSE PARTICLE. **Hiida, Kichiro (Tokyo Univ.); Kimura, Toshiei. Progr. Theoret. Phys. (Kyoto), 37: 162-82(Jan. 1967).**

An attempt is made to construct the most general theory of gravitational interaction when C, P, and T symmetries are not necessarily conserved separately. The gravitational interaction of an electromagnetic field is discussed in detail as a model case. It is shown that one may get a consistent and general covariant gravitational theory by taking both the metric tensor and the Affine connection as independent field variables. The Affine connection deviates from the Christoffel symbol and the geometry is not Riemannian. (auth)

27281 PRINCIPLES OF ELECTROMAGNETIC THEORY AND OF RELATIVITY. **Tonnelat, Marie-Antoinette. Dordrecht, Netherlands, D. Reidel Publishing Co., 1966. 485p. Translated from the French by Arthur J. Knodel.**

This book studies the principles upon which the classical and relativistic theories of the electromagnetic and gravitational fields are based. A simple exposition is presented of Maxwell's theory, of general relativity, and of special relativity. The experiments for checking the validity of the theories are described. Mathematical developments (tensor calculus in Euclidean vector space and in non-Euclidean metric manifold) are included as an appendix. (D.L.C.)

PHYSICS (HIGH ENERGY)

Particle Interactions and Properties (Experimental)

27282 (MIT–2098–299) PHYSICS PROGRESS REPORT NO. 69, OCTOBER 1, 1965–OCTOBER 1, 1966. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science). Oct. 1, 1966. Contract AT(30-1)-2098. 124p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Separate abstracts were prepared for the eight sections of this report. (C.E.S.)

For abstracts of individual sections see: 26150, 27018, 27283, 27317, and 27569–27572.

27283 (MIT–2098–299, pp 16–18) ACCELERATOR PHYSICS COLLABORATION. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science).

The program of the accelerator physics collaboration consists of four main parts. These are neutral decay modes of elementary particles and charge–exchange interactions, photo-induced interactions in a hydrogen bubble chamber, the development of a computer-controlled measuring and scanning machine, and the MIT 500-liter bubble chamber. A summary of previous experiments and expected progress is given. (J.F.P.)

27284 HUNTING CHARGES $\pm\frac{4}{3}$e IN THE COSMIC RADIATION. Buhler-Broglin, A.; Fortunato, G.; Massam, T.; Zichichi, A. (CERN, Geneva Univ., Bologna Instituto Nazionale di Fisica Nucleare, Bologna). Nuovo Cim. (10), 49A: 209-12(May 1, 1967).

Six plastic scintillation counters and two spark chambers were used to detect cosmic ray charge $\frac{4}{3}$ quarks above an energy cutoff at 1 GeV. The total number of incident cosmic particles beneath the iron roof was 2.25 $(10)^5$. On the basis of the pulse height distribution observed for singly charged particles, the efficiency for detecting charge $\frac{4}{3}$ quarks was estimated to be 53%. Four candidates were found, which is consistent with the expected background. The upper limit for the number of charge $\frac{4}{3}$ quarks in cosmic rays was found to be $(1.6 \pm 0.8)\ (10)^{-7}\ (\mathrm{cm}^{-2})(\mathrm{sr}^{-1})(\mathrm{s}^{-1})$. (J.F.P.)

Electromagnetic

Refer also to abstract 27529.

27285 (LNF–66/56) PAPERS PRESENTED AT INTERNATIONAL SYMPOSIUM ON ELECTRON AND POSITRON STORAGE RINGS, SACLAY, SEPTEMBER 1966. PART II. Note No. 337. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). Nov. 15, 1966. 37p. Dep.

Three papers on proposed experiments for the Adone storage rings are included. A separate abstract was prepared for each paper. (J.F.P.)

For abstracts of individual papers see: 27286–27288.

27286 (LNF–66/56, pp 3-13) PROJECT OF AN EXPERIMENT ON e^+e^- ANNIHILATION IN TWO BOSONS. Grilli, M.; Manno, V.; Soso, F.; Spillantini, P.; Visentin, R.; Nigro, M.; Schiavuta, E.; Valente, V.; Paoluzi, L. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). (CONF-660939–8).

From International Symposium on Electron and Positron Storage Rings, Saclay, France.

The preparation of an experiment on $e^+ + e^- \rightarrow \pi^+ + \pi^-$, $e^+ + e^- \rightarrow K^+ + K^-$, and $e^+ + e^- \rightarrow K_1^0 + K_2^0$ interactions to be done with Adone is described. These interactions will be studied in the energy range from 350 to 750 MeV. The experimental apparatus, the general criteria for the discrimination between the various particles produced, and the electronic masters to be used for the selection of the interactions in the various energy ranges are discussed. (J.F.P.)

27287 (LNF–66/56, pp 15-24) SINGLE BOSON PRODUCTION IN ADONE. Bartoli, B.; Bernardini, C.; Felicetti, F.; Silvestrini, V.; Goggi, A.; Scannicchio, D.; Vanoli, F.; Vitale, S. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). (CONF-660939–9).

From International Symposium on Electron and Positron Storage Rings, Saclay, France.

A proposed experiment for the accurate investigation of meson (ρ^0) production in Adone is described. The Adone as a boson mass spectrometer, the experimental setup, counting rate estimates, criterion for evidence of a peak, and the background are considered. (J.F.P.)

27288 (LNF-66/56, pp 25-36) PROJECT OF AN $e^+ + e^- \rightarrow \gamma + \gamma$ OR $\pi^0 + \gamma$ EXPERIMENT AT ADONE. Bacci, C.; Penso, G.; Salvini, G.; Capon, G.; Murtas, G. P.; Pellegrini, C.; Reale, A.; Spinetti, M.; Baldini-Celio, R. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). (CONF-66039-10).

From International Symposium on Electron and Positron Storage Rings, Saclay, France.

A proposed experiment for the detection of the interactions $e^+ + e^- \rightarrow \gamma + \gamma$ and $e^+ + e^- \rightarrow \pi^0 + \gamma$ is described. The storage ring Adone will be used for these experiments. An analysis of these interactions, the experimental apparatus, radiative corrections, counting rates, and background are discussed. (J.F.P.)

27289 (NP-16737) PHOTOPRODUKTION VON POSITIVEN PI-MESONEN ZWISCHEN 1.2 UND 3 GeV IM SCHWERPUNKTS-WINKELBEREICH VON 2.5°–15°. (Photoproduction of Positive π Mesons Between 1.2 and 3 GeV in the Center-of-Mass Angles Region From 2.5° to 15°). Koetz, U. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Mar. 1967. 57p. (In German). Dep.

The reaction $\gamma p \rightarrow \pi^+ n$ was investigated for photon energies between 1.2 and 3 GeV and pion center-of-mass angles from 2.5 to 15°. In the energy region of the nucleon isobars $N^*_{3/2}$ (1920) and $N^*_{3/2}$ (2190) the differential cross section shows resonance structure which becomes more pronounced with decreasing production angle. The observed forward peaking in all angular distributions is in disagreement with simple one-pion exchange models. Models which take into account the interference between the one-pion exchange and the nucleon pole (s-channel) graph and also final-state absorption are in qualitative agreement with the experimental results only at small angles and low energies. (auth)

27290 (NP-16741) PHOTOEINFACHPRODUKTION POSITIV GELADENER pi-MESONEN ZWISCHEN 1.2 UND 3 GeV IM LABOR-WINKELBEREICH VON 8°–20°. (Photomonoproduction of Positively-Charged π Mesons Between 1.2 and 3 GeV in the Laboratory Angle Region From 8°–20°). Schmueser, P. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Mar. 1967. 70p. (In German). Dep.

The reaction $\gamma + p \rightarrow \pi^+ + n$ was investigated for incident photon energies between 1.2 and 3 GeV and pion production angles between 8 and 20 degrees in the lab system. The differential cross sections $d\sigma/d\Omega^*$ show resonance structure in the energy region corresponding to the nucleon isobars $N^*_{3/2}(1920)$ and $N^*_{3/2}(2190)$. At photon energies above 1.7 GeV, the cross sections $d\sigma/dt$ drop nearly exponentially as functions of four-momentum transfer. Presently existing theoretical models are only partly successful in describing the experimental behavior. The simple peripheral model (gauge invariant one-pion exchange) predicts a t-dependence which strictly disagrees with the results of this experiment. If final-state absorption is taken into account the situation is considerably improved, but still the decrease of $d\sigma/dt$ with $|t|$ is less rapid than experimentally observed. However, this absorption model gives the correct order of magnitude for the cross sections. Interpretation in terms of Regge-π-exchange does not seem to be adequate since there is still resonance structure in the energy region considered. The vector-meson dominance model predicts values for the total cross sections which agree with the experimental results within a factor of two. Also a predicted t-dependence at 1.7 GeV is in qualitative agreement with this experiment. (auth)

27291 (NP-16765) MESSUNGEN DER ELEKTROMAGNETISCHEN FORMFAKTOREN BEI VIERERIMPULSUEBERTRAEGEN VON 10 BIS 110 FERMI^{-2}. (Measurement of the Electromagnetic Form Factors for Four Momentum Transfers From 10 to 110 Fermi^{-2}). Engler, Joachim (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Mar. 1967. 68p. (In German). Dep.

Using the internal beam of DESY elastic electron–proton cross sections were measured at various angles between 32 and 130°, and with momentum transfers of $q^2 = 39$, 60, 80 and 110 f^{-2}. Two single quadrupole spectrometers, movable around a common liquid-hydrogen target, were used for analyzing the momentum of the scattered electrons. Cherenkov and shower counters discriminated against pion and low-energy background. As a cross section reference recoil protons from elastic scattering at $q^2 = 10\ f^{-2}$ were used, with a quantameter serving as an intermediate monitor. The data are consistent with the Rosenbluth formula, giving real form factors G_E and G_M. Both continue to decrease with increasing momentum transfer, but somewhat faster than indicated by measurements performed so far. The comparison of the e-p cross sections with those of p-p scattering and photoproduction of pions respectively shows nearly the same exponential decrease in all three cases. Among the meson resonance models the simple dipole ansatz reproduces the form factors in the whole region up to $q^2 = 250\ f^{-2}$. (auth)

27292 LABORATORY ANGULAR AND MOMENTUM DISTRIBUTIONS OF PROTONS, KAONS AND PIONS FROM PHOTOPRODUCTION ON HYDROGEN AT ENERGIES UP TO 5.8 GeV. **Brall, U. (Technische Hochschule, Aachen); Erbe, R.; Reimann, G.; (and others). Nucl. Phys., B1: 668-78(1967).**

Information is presented on the laboratory angular and momentum distributions of protons, π^+ and π^- mesons and K_1^0 mesons produced by a photon beam with an approximate bremsstrahlung spectrum on hydrogen. The data may be useful for designing secondary pion and kaon beams, for planning experiments and for background estimates at electron accelerators. (auth)

27293 PHOTOPRODUCTION OF STRANGE PARTICLES AT ENERGIES UP TO 5.8 GeV. **Erbe, R. (Technische Hochschule, Aachen); Reimann, G.; Schuettler, E.; (and others). Nuovo Cim. (10), 49A: 504-10(June 1, 1967).**

Photoproduction of strange particles was studied in an 84-cm hydrogen bubble chamber exposed to a bremsstrahlung beam of 5.8 GeV maximum energy. 1,200,000 pictures were evaluated resulting in a total of 709 events with visible strange-particle decays. Cross sections and effective mass distributions are presented and discussed for the following reactions: $\gamma p \rightarrow \Lambda K^+$, $\gamma p \rightarrow \Sigma^0 K^+$, $\gamma p \rightarrow \Sigma^+ K^0$, $\gamma p \rightarrow \Lambda K^+ \pi^0(\pi^0 \ldots)$, $\gamma p \rightarrow \Lambda K^0 \pi^+$, $\gamma p \rightarrow \Sigma^+ K^+ \pi^-$, $\gamma p \rightarrow \Sigma^- K^+ \pi^+$, and $\gamma p \rightarrow \Lambda K^+ \pi^+ \pi^-$. Evidence was found for the Y_1^* (1385) in the $\Lambda\pi$ mass distribution; a considerable fraction of the Y_1^* peak is attributed to reactions involving one or more π^0 mesons. (L.B.S.)

27294 MUON-PAIR DECAY MODES OF THE VECTOR MESONS. **Wehmann, A. (Harvard Univ., Cambridge, Mass.); Engels, E. Jr.; Hoffman, C. M.; Innocenti, P. G.; Wilson, Richard; Blanpied, W. A.; Drickey, D. J.; Hand, L. N.; Stairs, D. G. Phys. Rev. Lett., 18: 929-32(May 22, 1967).**

Results of a further analysis of data on the production of meson (μ) pairs by a negative 12-GeV/c meson (π) and meson (K) beam are presented. Four separate determinations of the $\rho^0 \rightarrow 2\mu$ branching ratio based on the data taken using carbon as well as the iron target are made, and the data are compared with production cross sections taken from both hydrogen and heavy liquid bubble chamber data. In addition, angular distributions of the meson(μ) pairs which are presented as a function of four momentum transfer suggest the possibility of some ω^0 production. Finally observation of the decay $\phi \rightarrow 2\mu$ based on the events produced using incident mesons (K^-) is reported. (J.F.P.)

27295 MEASUREMENTS OF π^0 PHOTOPRODUCTION CROSS SECTIONS FOR INCIDENT GAMMA-RAY ENERGIES OF 2.0 TO 5.0 GeV. Bolon, G. C.; Garelick, D.; Homma, S.; Lewis, R.; Lobar, W.; Luckey, D.; Osborne, L. S.; Schwitters, R.; Uglum, J. (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-2098. Phys. Rev. Lett., 18: 926-9(May 22, 1967). (MIT-2098-310).

Cross sections for the reaction $\gamma + p \rightarrow \pi^0 + p$ for incident gamma energies of 2.0 to 5.0 GeV and for baryon four-momentum transfers squared of 0.5 to 4.0 $(GeV/c)^2$ are presented. The results are compared with theoretical predictions based on Reggeized vector meson exchange. (auth)

27296 PHOTOPRODUCTION OF Y^{*0} RESONANT STATES. **Mistry, N. B. (Cornell Univ., Ithaca, N. Y.); Mori, S.; Sober, D. I.; Sadoff, A. J. Phys. Lett., 24B: 528-30(May 15, 1967).**

The photoproduction from hydrogen of neutral hyperon resonant states Y_1^*(1385 MeV) and Y_0^*(1405 MeV) was measured at a center-of-mass angle of 90°, and average photon energies of 1450 MeV and 1525 MeV. An upper limit is set for the photoproduction of the resonant state Y_0^*(1520 MeV). (auth)

Weak

27297 TEST OF TIME-REVERSAL INVARIANCE IN K/sub mu/$_3{}^0$ DECAY. **Young, Kenneth K. (Univ. of Michigan, Ann Arbor); Longo, Michael J.; Helland, Jerome A. Contracts NONR 1224(23); AT(11-1)-34. Phys. Rev. Lett., 18: 806-10 (May 8, 1967).**

The results are reported of an experiment to test time-reversal invariance in the decay $K_L^0 \rightarrow \mu^+ + \pi^- + \nu$ ($K_{\mu 3}^0$ decay) by searching for a component of the muon polarization that is transverse to the decay plane. The experiment employed conventional scintillation-counter techniques. The results are found to be consistent with no violation of T invariance, and are in definite disagreement with the model of Cabibbo which predicted 1 Arg ξ 1 ≅ ½. (L.B.S.)

27298 REGENERATION PHASE AND THE RELATIVE PHASE OF K_L AND K_S IN THE $\pi^+\pi^-$ DECAY. Rubbia, C. (CERN, Geneva); Steinberger, J. Phys. Lett., 24B: 531-3(May 15, 1967).

The regeneration phase of K_S relative to K_L was redetermined using new data for the total K^+ and K^- cross sections. It is found that $\cos \Phi_f = 1.06 \pm 0.09$. If this result is combined with measurements of the interference between regenerated K_S and K_L in the $\pi^+\pi^-$ decay, the phase of the CP violating amplitude η_{+-} is $\Phi\eta_{+-} = (1.47 \pm 0.30)$ sign Δm. (auth)

Strong (Baryon-Induced)

27299 (BNL-11372) TOTAL CROSS SECTIONS OF K MESONS AND ANTIPROTONS ON NUCLEONS UP TO 3.3 GeV/c. **Kycia, T. F. (Brookhaven National Lab., Upton, N. Y.). [1967]. Contract AT(30-2)-Gen-16. 35p. Dep. CFSTI.**

A search was made for the possible existence of higher mass baryon resonances with strangeness +1 and −1 as well as for higher mass boson resonances. Total cross section measurements with mesons (K^-) and (K^+) are extended out to 3.3 GeV/c, and also antinucleon−nucleon total cross sections were measured at 50-MeV/c intervals between 1.0 and 3.3 GeV/c. Also the total cross sections of mesons (K^+) and (K^-) and antiprotons of neutrons bound in deuterons were measured in order to establish the resonance isotopic spin. The total cross sections obtained for these interactions are shown. (J.F.P.)

27300 (NEVIS-159) SEARCH FOR MASSIVE FUNDAMENTAL PARTICLES; OBSERVATION OF ANTIDEUTERONS. **Dorfan, David Elliot (Columbia Univ., Irvington-on-Hudson, N. Y. Nevis Labs.). Feb. 1967. Contract AT(30-1)-1932. 87p. (R-580; CU-263). Dep. CFSTI.**

Thesis.

An experiment was performed at the AGS to search for negative, quasi-stable (lifetime > 10^{-7} sec) particles in the mass range 3 to 7 BeV/c^2. This search was provoked by theoretical speculations concerning the existence of "quarks" or unitary symmetry particles. The search sought to identify these particles by their mass, using time-of-flight techniques and Cherenkov counters in a 4.75° secondary beam produced by collisions of the primary beam with beryllium and stainless steel targets. No particles in the mass range 3 to 7 BeV/c^2 were observed and the following are the limits on production cross sections for these particles: $d^2\sigma/d\Omega dp\ (p + Fe) < 9 \times 10^{-36}\ cm^2\ sr^{-1}\ (BeV/c)^{-1}$ and $d^2\sigma/d\Omega dp\ (p + Be) < 2 \times 10^{-36}\ cm^2\ sr^{-1}\ (BeV/c)^{-1}$. Two ancillary experiments are also described. In the first a detailed study, using the bevatron and accelerator, of the production of antiprotons from copper targets at bombarding energies far below the threshold energy for antiproton production from nucleon-nucleon collisions is reported. The object of this study was to provide data on the effect of internal nuclear structure on the energy available from collisions of high energy protons with complex nuclei. These results are used to estimate the nuclear effects in the AGS search for massive particles. In the second experiment, the mass spectrometer system was tuned to the mass region near 2 BeV/c^2. A mass peak observed there was established to belong to antideuterons by a variety of separate tests. The production cross section relative to negative pions was measured to be $\sim 5 \times 10^{-8}$. This is shown to be consistent with a plausible production model. (auth)

27301 A DETAILED EXPERIMENTAL ANALYSIS OF NUCLEON-NUCLEON COLLISIONS BETWEEN 10^{12} eV AND 10^{14} eV. **Rybicki, K. (Inst. of Nuclear Research, Krakow). Nuovo Cim. (10), 49A: 233-60(May 21, 1967). (INR-734/VI/PH).**

24 nucleon-nucleon collisions at the energy of 1 to 100 TeV have been analyzed in detail. Due to large dimensions of emulsion stack the available path of secondary tracks in it was comparable with interaction length. This analysis included search for electron pairs (98 found), and neutral secondary interactions (9 found), tracing of secondary tracks (63 interactions were found this way) and a study of subsequent electromagnetic cascade. As a result a small-angle region and the energy balance could be explored much better than it had been done previously. An attempt to estimate the primary energy independently of the angular distribution of the primary jet was done. It is shown that the incident nucleon is deflected during collision in which it loses on the average about 40% of its primary energy and its transverse momentum can be as high as a few GeV/c. In the energy region up to 8 TeV all events can be interpreted in terms of emission of one or, more often, two fireballs. At higher energies, however, in the majority of cases angular distribution differs from the one- or two-fireball description. These jets can be tentatively interpreted in terms of emission of more than two fireballs. (auth)

27302 PROTON–NEUTRON QUASI-ELASTIC SCATTERING AT 991 MeV. **Murray, T. A.; Riddiford, L.; Grayer, G. H.; Jones, T. W.; Tanimura, Y. (Univ. of Birmingham, Eng.). Nuovo Cim. (10), 49A: 261-72(May 21, 1967).**

The proton-proton and proton-neutron elastic-scattering angular distributions were measured at 1.69 GeV/c (=991 MeV) from 14.5 to 150° c.m.s. using fast scintillation counters in conjunction with magnetic-momentum analysis. In both cases, the forward elastic cross sections are considerably in excess of their respective optical-theorem minima, the results being consistent with the existence of a real part in the $T = 0$ scattering amplitude together with spin dependence in both interactions. The proton-neutron angular distribution is more strongly asymmetric about 90° c.m.s. than it is at lower energies, indicating the onset of diffraction scattering and increased interference between the scattering amplitudes in the $T = 0$ and $T = 1$ I-spin states. At the larger center-of-mass angles, the data suggested that substantial corrections were necessary because of the inapplicability of the impulse approximation as a result of multiple nuclear scattering in the deuteron, necessitating a measurement of the ratio of quasi-elastic to elastic proton-proton scattering from 100 to 150° c.m.s. (auth)

27303 NEUTRON–PROTON BREMSSTRAHLUNG AT 197 MeV. **Koehler, P. F. M.; Rothe, K. W.; Thorndike, E. H. (Univ. of Rochester, N. Y.). Phys. Rev. Lett., 18: 933-6(May 22, 1967).**

A more reliable npγ cross section measurement is provided. The experiment was performed using a proton beam and a target of almost free neutrons in deuterium. The proton-deuteron radiative processes are interpreted by an extension of the spectator model. Inferred free n–p bremsstrahlung cross sections are given. (J.F.P.)

Strong (Meson-Induced)

27304 (INR–774/VI/PH) COHERENT PRODUCTION OF PARTICLES IN COLLISIONS OF 200 GeV PIONS WITH EMULSION NUCLEI. **Czachowska, Z.; Gierula, J.; Krzywdzinski, S.; Miesowicz, M.; Rybicki, K.; Wolter, W. (Institute of Nuclear Research, Warsaw (Poland)). 1967. 12p. Dep.**

In about 75 liters of nuclear emulsion irradiated by the primary cosmic radiation 62.86 m of secondary tracks were systematically traced. These tracks belong to mesons of median energy of about 200 GeV produced in interactions of ultra high energy nucleons with emulsion nuclei. Among 144 jets found in this way about 9% represent events with $N_h = 0$ and $n_s = 3$ or $n_s = 5$ nearly all of which have all features of diffraction dissociation of pions. (auth)

27305 (JINR–E1-3267) THE REAL PART OF π^-p ELASTIC SCATTERING AMPLITUDE IN THE COULOMB INTERFERENCE REGION AT 3.48 AND 6.13 GeV/c. Nomofilov, A. A.; Sitnik. I. M.; Slepets, L. A.; Strunov, L. N.; Zolin, L. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1967. 11p. Dep.

The real part of the nuclear amplitude was determined from the interference of the Coulomb and nuclear interactions. Recoil protons were used to detect elastic scattering events for the squared four-momentum transfers of $1.22 \times 10^{-3} \leq -t \leq 4.22 \times 10^{-3}(\mathrm{GeV/c})^2$ with the t-resolution $\Delta t \approx 1 \times 10^{-4}(\mathrm{GeV/c})^2$. The analysis of the elastic π^-p differential cross section using the Bethe formula gives values of $a_B = (\mathrm{Re}\ A_n/\mathrm{Im}\ A_n) = -(0.17 \pm 0.07)$ and $a_B = -(0.22 \pm 0.09)$ for 3.48 GeV/c and 6.13 GeV/c, respectively. The similar analysis using the formula of L. D. Soloviev results in $a_s = -(0.12 \pm 0.07)$ and $a_s = -(0.17 \pm 0.09)$ for 3.48 GeV/c and 6.13 GeV/c, respectively. The experimental values of ReA_n are in agreement with those calculated on the basis of the forward dispersion relations. (auth)

27306 (JINR–P1-3248) DVOINAYA PEREZARYADKA Π-MEZONOV NA YADRAKH V FOTOEMULISII (Double Charge Exchange of Π-Mesons by Nuclei in Photoemulsion). Batusov, Yu. A.; Bunyatov, S. A.; Sidorov, V. M.; Yarba, V. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1967. 26p. (In Russian). Dep.

The total cross sections of a double exchange of Π^+ and Π^- mesons in the energy range of 40–176 MeV are measured. The energy and angular distributions of secondary Π-mesons are given. The prong distributions of "stars", accompanying these processes in photoemulsion, are discussed. The experimental results are compared to the calculations performed on the cascade model. (auth)

27307 ADDITIONAL INFORMATION ON THE INTERACTION CROSS SECTIONS OF ELEMENTARY PARTICLES AT HIGH ENERGIES. Artykov, I.; Gruzdeva, V. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uz. SSR, Ser. Fiz.-Mat. Nauk, No. 5, 93-4(1966). (In Russian).

The total range L_t of an elementary particle in a photoemulsion and the range to the elastic interaction L_{el} were plotted as a function of the total interaction cross section σ_t. The optical model was used in the calculations. The form of the curve did not depend on the type of incident particle. Hence, the curves can be used to determine the interaction cross section of the particles from the range. The interaction cross sections were found to be 1.00 for the N particle, 0.95 for the π particle and 0.90×10^{-27} cm for the K particle stopped in iron, and 2.30 for the N particle, 2.00 for the π particle and 2.00×10^{-27} cm for the K particle stopped in Pb. The calculated results were in good agreement with the experimental values. (TTT)

27308 REACTION $K^+p \rightarrow K\Delta\pi$ IN ALL THREE FINAL CHARGE STATES AT 3 GeV/c. Saellstroem, P.; Otter, G.; Ekspong, G. (Univ. of Stockholm). Nuovo Cim. (10), 49A: 348-17(June 1, 1967).

The reaction $K^+p \rightarrow K\Delta\pi$ was studied in all three final charge states at a momentum of the incident K-meson of 2.97 GeV/c. The resonance K*(890) is produced with a cross section of (1.56 ± 0.19) mb and a decay branching ratio $(K^* \rightarrow K^+\pi^0)/(K^* \rightarrow K^0\pi^+) = 0.43 \pm 0.11$. The resonance $\Delta^*(1236)$ is produced as Δ^{*++} with the cross section (0.70 ± 0.13) mb and as Δ^{*+} with the cross section (0.27 ± 0.08) mb. The decay branching ratio of Δ^{*+}, $(\Delta^* \rightarrow n\pi^+)/(\Delta^* \rightarrow p\pi^0)$ is 0.05 ± 0.20. The consequences of an interference between states with different isotopic spin of the $(\Delta\pi)$-system are discussed. The decay correlations of the resonance events are presented and the spin space density matrix elements for the resonances are calculated. The Δ^* decay distributions agree with the predictions of the model of Stodolsky and Sakurai. The decay angular correlations of the two decay modes of K*, $K^* \rightarrow K^0\pi^+$ and $K^* \rightarrow K^+\pi^0$, are found to be significantly different. This may be explained as due to an interference between states with different isotopic spin of the $(K\pi)$-system. The K* decay correlations, when interference effects are eliminated, indicate that the resonance is produced to a great extent via the exchange of a vector meson (one-meson exchange model). The production angular distributions of both resonances are sharply peaked. The modified one-particle exchange model of Jackson et al., is shown to give a reasonable account of these distributions as well as of the decay correlations and the variation of the density matrix elements with the production angle of the resonance. (auth)

27309 $K\pi\pi$ SYSTEMS IN FOUR-BODY FINAL STATES PRODUCED IN HYDROGEN BY 3, 3.5, AND 5 GeV/c K^+ MESONS. De Baere, W. (Institut Interuniversitaire des Sciences Nucleaires, Brussels); Debaisieux, J.; Dufour, P.; (and others). Nuovo Cim. (10), 49A: 373-92(June 1, 1967).

In a study of the reaction $K^+p \rightarrow K\Delta\pi\pi$ in the 81 cm Saclay hydrogen bubble chamber, exposed at CERN to separated K^+ mesons of 3, 3.5 and 5 GeV/c, strong evidence was found for an enhancement in the mass spectrum of the I-spin ½ K*(892)π system. Even though the phenomenon is beyond any statistical doubt, it is difficult and probably not meaningful to assign to it well-defined mass and width values since the enhancement occupies the whole region between 1 and 1.5 GeV/c^2 and since the position of the peak appears to move with incident momentum. It is therefore unlikely that the effect is due to a single resonance. An explanation in terms of the peripheral model (Deck mechanism) meets with severe difficulties. An interpretation as a superposition of adjacent resonances seems acceptable as several resonances have been proposed in this mass region. However, since only one of them, the K*(1400), is well established, our effect calls for at least one additional resonance. In the simplest assumption of two adjacent resonances one would be the K*(1400) and the other a K* of mass ~1270 MeV/c^2 with a width ~200 MeV/c^2. (auth)

27310 SINGLE-PION PRODUCTION WITH π^-p AT 3 GeV/c. Clear, D. R. (Univ. of Toronto); Johnston, T. F.; Pilcher, J.; (and others). Nuovo Cim. (10), 49A: 399-414(June 1, 1967).

The properties of the strangeness-zero resonances which are observed in 2-prong events produced by 3 GeV/c π^-p interactions are discussed. The ρ^-, ρ^0 and f^0 dipion states are present. The usual asymmetric ρ^0 decay distribution is found and may be taken as marginal evidence for the $T = 0$, S-wave, ϵ^0. One feature of our data which is unusual in these final states is the presence of the Δ^*(1238) in several channels, particularly π^0p and π^-n. (auth)

27311 STRANGE-PARTICLE PRODUCTION AT 2.75 GeV/c. I. THE YKπ FINAL STATE. Dahl, D.; Labenski, F.; Litvak, J.; Saragovi, C.; Waisman, E. (Comision Nacional de Energia Atomica, Buenos Aires). Nuovo Cim. (10), 49A: 1-8(May 1, 1967).

The strange particle production in π^- +p reactions at 2.75 GeV/c was analyzed. The results concerning the three-body final state are presented. The rate of production of the different known resonances is determined by best fit procedures. The Y_0^*(1405) was found at 1375 MeV, as was also found by Miller, et al. The one-K exchange peripheral model was tested by the Treiman-Yang test, obtaining consistency when K*(891) production is favored. The total cross section was found to be $\sigma_T = (1.4 \pm 0.1)$ mb. (auth)

27312 STUDY OF THE REACTIONS $K^+p \rightarrow K^*\mathcal{N}^*$ AT 3.5 AND 5 GeV/c. George, R. (CERN, Geneva); Goldschmidt-Clermont, Y.; Henri, V. P.; (and others). Nuovo Cim. (10), 49A: 9-32(May 1, 1967.

From a study of the four-body final state $K^+p \rightarrow K\mathcal{N}\pi\pi$ at 3.5 and 5 GeV/c it is found that the quasi-two-body reaction $K^+p \rightarrow$ K*(892)$\mathcal{N}^*$(1236) is produced in large amount. This reaction shows the same general behavior as obtained at 3 GeV/c: sharply peaked production angular distributions suggesting peripheralism as the mechanism of production. The experimental angular distributions are compared with the predictions of three models: one-pion exchange with arbitrary form factors, absorption with pion exchange, simple Regge-pole exchange. The results show that the absorption model with π exchange predicts the shape for the production angular distribution reasonably well but less well the energy dependence of the production cross section. It predicts rather well the general trend of the density matrix elements characterizing the decay distributions. It also succeeds in accounting for the experimental angular correlations between the K* and $\mathcal{N}^*$ decay. The simple Regge-pole exchange gives acceptable results for both the shape and energy variation of the production angular distributions. The observed K*(1400)$\mathcal{N}^*$(1236) reaction at 5 GeV/c gave production and decay distributions in qualitative agreement with a 2^+ K* (1400) produced in a π exchange process. (auth)

27313 EXPERIMENTAL EVIDENCE AGAINST THE EXISTENCE OF THE S^0 MESON. Buhler-Broglin, A.; Dalpiaz, P.; Massam, T.; Navarria, F. L.; Schneegans, M. A.; Zetti, F.; Zichichi, A. (CERN, Geneva. Univ., Bologna. Istituto Nazionale di Fisica Nucleare, Bologna). Nuovo Cim. (10), 49A: 183-93(May 1, 1967).

An experiment was performed which is similar in energy and angular acceptance to that in which the evidence for the existence of the S^0 meson was originally reported. The data obtained do not show any evidence for the existence of the S^0 meson. Upper limits for the production cross sections of neutral resonances of various widths in the mass region (660 to 850) MeV are also given in terms of the observed ω cross section. (auth)

27314 SEARCH FOR A Y_2^* RESONANCE IN THE $\Sigma^-\pi^-$ CHANNEL. Bell, Robert B.; Ely, Robert P.; Pan, Yu-li (Univ. of California, Berkeley). Phys. Rev. Lett., 18: 921-3(May 22, 1967).

The reaction $K^- + d \rightarrow \Sigma^- + \pi^+ + \pi^- + p$ in the K^-n cm energy range from 1660 to 1900 MeV was examined in an attempt to confirm the existence of the Y_2^* (1415) reported previously. The evidence for this isobar was based on a study of the reaction $K^- + n \rightarrow \Sigma^- + \pi^+ + \pi^-$ in a heavy liquid chamber. In this experiment mesons (K^-) having incident momenta of 815, 1015, and 1115 MeV/c interacted in a deuterium bubble chamber. A cross section of less than 0.02 mb is found for Y_2^* production. (J.F.P.)

27315 Y_0^*(1520) MASS, WIDTH, AND DECAY FRACTIONS. Dauber, P. M.; Malamud, E. I.; Schlein, P. E.; Slater, W. E.; Stork, D. H. (Univ. of California, Los Angeles). Phys. Lett., 24B: 525-8(May 15, 1967).

The decay fractions of the Y_0^*(1520) were measured using the reaction $K^-p \rightarrow Y_0^*(1520)\,\pi^+\pi^-$ at 2.0 GeV/c incident momentum. They are $\overline{K}N : \Sigma\pi : \Lambda\pi\pi = (52 \pm 4) : (37 \pm 4) : (11 \pm 2)$. The best values for the mass and width are 1518.0 ± 0.7 MeV and 16 ± 2 MeV. (auth)

27316 PROOF THAT THE NEAR-FORWARD MINIMUM AND SECONDARY PEAK IN pi$^-$p ELASTIC SCATTERING ARE RESONANCE EFFECTS. Hoff, G. T. (Univ. of Illinois, Chicago). Phys. Rev. Lett., 18: 816-21(May 8, 1967).

It is deduced using a very general and simple approach that the differential cross section minimum near the forward direction and secondary diffraction peak in π^-p elastic scattering in the region from 1.7 to 2.5 BeV/c are resonance phenomena. Experiments of simple interpretation are proposed to determine if this is the general nature of the dip-secondary-peak sequence observed in various reactions. (auth)

Particle Interactions and Properties (Theoretical)

General

27317 (MIT-2098-299, pp 83-115) THEORETICAL GROUP. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science).

Various theories for elementary particle interactions and decay processes are described. Also theories for nuclear reactions especially for deuteron and nucleon reactions with nuclei are given. (J.F.P.)

27318 CALCULATING THE MASS SPECTRUM OF ELEMENTARY PARTICLES. Akulov, N. S. Dokl. Akad. Nauk BSSR, 10: 923-5(Dec. 1966). (In Russian).

It is assumed that all hadrons are made of muons and pions. The mass is written as follows: $M = Z_\mu m_\mu + Z_\pi m_\pi - \delta$. Here Z_μ and $Z_\pi = 0, 1, 2, 3 \ldots$, and δ is a quantity characterizing the change in mass on combining muons and pions. Since the spin is ½ for muons and zero for pions, $Z_\mu = 2n + 1$ for fermions, and $Z_\mu = 2n'$ for bosons, where n and n′ are whole numbers. Thus elementary particles can be classed in families according to the value of Z_μ and Z_π. The mass of a muon is related to the mass of a pion as 3 to 4. The rest mass of a neutrino m_ν is assumed to be 35 MeV, and $\delta = Z_d m_\nu$, where Z_d takes on whole number values of 0, 1, and 3. The masses of elementary particles calculated by these relations are in good agreement with experimental values. The selection of possible values of Z_μ are limited by the spin and stability of the particles. Pions combine mainly with stable particles such as a nucleon or kaon. The mass of the kaon indicates that this boson consists of two muons and two pions. (TTT)

27319 LINEAR REPRESENTATION OF SPINORS BY TENSORS. Cercignani, Carlo (Univ., Milan). J. Math. Phys. (N. Y.), 8: 417-22(Mar. 1967).

A linear representation of spinors in n-dimensional space by tensors is proposed. In particular, in three-dimensional space a set composed by a scalar and a vector is associated to any two-component spinor, while in four-dimensional space the set corresponding to a four-component spinor is composed by a scalar, a pseudoscalar, a vector, a pseudovector, and an antisymmetrical tensor of second order. The resulting formalism is then applied to Schrödinger's and Dirac's equations. In three-dimensional space it turns out that the proposed procedure automatically assigns an intrinsic magnetic moment to an electron in a magnetic field without introducing any relativistic ideas or ad hoc assumptions. In four-dimensional space one can write the Dirac equation in a generally covariant fashion, without introducing new concepts with respect to the usual tensor analysis. The zero-mass Dirac equation splits into two sets of equations, describing respectively the neutrino and the photon. The possible bearing of the proposed approach upon the theories of elementary particles is briefly discussed. (auth)

27320 COMMUTATION OF AXIAL CHARGE WITH AXIAL DIVERGENCE. Ahmed, M. A. (Univ. of Durham, Eng.). Nucl. Phys., B1: 679-85(1967).

The consequences of a certain commutator between the axial charge and the axial divergence constructed from the strangeness-changing weak axial-vector current are investigated. A value for the F/D ratio in good agreement with the experiment is obtained. Finally a discussion of compatibility with the quark model is given. (auth)

27321 MIXED IRREDUCIBLE REPRESENTATIONS FOR U_3. Flores, Jorge (Princeton Univ., N. J.). Contract AT(30-1)-937. J. Math. Phys. (N. Y.), 8: 454-9(Mar. 1967). (PUC-937-221).

Some properties of irreducible representations of the unitary group in three dimensions U_3 with positive and negative indices are studied. These representations are useful for the group theoretical classification of particle-hole states in nuclear shell theory, as well as in elementary particle physics. It is shown how the rules for reducing the direct product of two given representations should be modified when positive and negative indices are included and these rules are used to obtain an algebraic expression for the irreducible representations contained in the direct product. (auth)

27322 GROUP PROPERTIES OF ONE-DIMENSIONAL OPERATORS OF COMPLEX CO-ORDINATE AND MOMENTUM IN QUANTUM MECHANICS. Sannikov, S. S. (Physico-Technical Inst., Karkov). Nucl. Phys., B1: 686-7(1967).

Infinitesimal operators of the L_4 Lorentz group are constructed of one-dimensional operators of complex co-ordinate and momentum in quantum mechanics. The operators generate a representation which belongs to a new representation class of the L_4 Lorentz group. (auth)

27323 FIVE-DIMENSIONAL ASPECT OF FREE PARTICLE MOTION. De Vos, J. A.; Hilgevoord, J. (Univ., Amsterdam). Nucl. Phys., B1: 494-510(1967).

The mass of a free particle is introduced as a fifth space-like co-ordinate p^5 in momentum space. This leads to the consideration of the deSitter-covariant fields, satisfying the Klein-Gordon equation in five-dimensional form $(p^\mu p_\mu + p^5 p_5)\psi = 0$; i.e., the length squared of the five-momentum is zero. In this case the little group is a three-dimensional Euclidean group. The de Sitter-covariant wave equations defining the unitary representation of the inhomogeneous de Sitter group contained in such fields can now immediately be written down by expressing the fact that the translations of the little group must be represented trivially. In this manner it is found that there exist Lorentz-covariant wave equations for any spin, among which are included the Bargmann-Wigner equations, the Proca and Kemmer equations, that are also de Sitter-covariant wave equations if the mass is considered simply as a fifth coordinate in momentum space. A general expression for the spin tensor of such fields is obtained. (auth)

27324 QU'EST-CE QU'UNE PARTICULE ELEMENTAIRE? (What Is an Elementary Particle?) Diu, Bernard. Collection de Monographies de Physique. Paris, Masson and Cie Editeurs, 1965. 169p. 38F.

The discussion of the concept of an elementary particle includes a review of some elementary ideas, that is, the four kinds of interactions and the conservation laws, a definition of the S-matrix and scattering amplitude, unitarity, dispersion relations, Mandelstam representations, and a definition of the Lee model. Also discussed are various attempts to distinguish between elementary and composite particles including an example of the generalized Lee model, Regge poles and unitary symmetry, the general idea of bootstrap and attempts to apply this theory to the approximation for one channel and attempts to improve these results by the addition of a second channel. The difficulties and prospects for bootstrap theory are considered. (J.F.P.)

Electromagnetic

Refer also to abstract 27643.

27325 (JINR-E2-3203) SYMMETRIES AND CURRENT ALGEBRAS FOR ELECTROMAGNETIC INTERACTIONS. **Solov'ev, L. D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1967. 22p. (CONF-670203-3). Dep.**

From International Conference on Electromagnetic Interactions at Low and Intermediate Energies, Dubna, USSR.

Applications of the current algebras method to electromagnetic interactions are summarized and its connection with the supercovergent sum rules method is pointed out. (auth)

27326 BREMSSTRAHLUNG DUE TO THE COLLISION OF A MUON WITH A RESTING ELECTRON. Galitskii, V. M.; Kel'ner, S. R. (Moscow Engineering-Physics Inst.). Zh. Eksp. Teor. Fiz., 52: 1427-33(May 1967). (In Russian).

The bremsstrahlung process due to the collision of a fast muon and a fixed electron is considered. The photon spectrum is calculated for frequencies which considerably exceed those corresponding to the electron mass. (auth)

27327 RADIATIVE POLARIZATION OF ELECTRONS IN A MAGNETIC FIELD. Baier, V. N.; Katkov, V. M. (Novosibirsk State Univ., USSR). Zh. Eksp. Teor. Fiz., 52: 1422-6(May 1967). (In Russian).

Electron polarization due to radiation in a nonuniform magnetic field is investigated by applying the operator formulation of the quasiclassical approximation. A general expression is obtained for the radiative transition probability involving spin flip in an arbitrary magnetic field. (auth)

27328 EMISSION OF RADIATION DURING TWO-PARTICLE ANNIHILATION OF AN ARBITRARILY POLARIZED ELECTRON-POSITRON PAIR. Morozov, D. F. Zh. Eksp. Teor. Fiz., 52: 1212-20(May 1967). (In Russian).

The polarization contribution to the exact differential cross section for emission of a photon in two-particle annihilation of an arbitrarily polarized electron-positron pair is calculated by the method of invariant tensor integration. The polarization contributions to the integral cross sections are calculated for a longitudinal and transverse polarized electron-positron pair. The effect of polarization on the cross section for photon emission by initial particles annihilating into a pair of any other particles is considered by taking into account the form factors of the latter particles. A simple method is suggested for calculating tensor contractions in calculations of the cross sections for some processes carried out by the Bayer-Hose technique. It is not required to calculate the tensors themselves and hence the efficiency of the method is enhanced. (auth)

27329 QUARK DISSOCIATION MODEL OF PHOTOPRODUCTION. **Kajantie, K.; Trefil, J. S. (CERN, Geneva). Nucl. Phys., B1: 648-54(1967).**

The quark model for photoproduction which was recently proposed to explain the suppression of φ production is investigated in more detail. A number of clean tests of the model are suggested. Comparison is made with available data. (auth)

27330 INTERACTION OF NEUTRAL K AND ELECTROMAGNETIC FIELDS. I. QUANTIZATION OF COUPLED FIELDS. **Spitzer, Richard (Univ. of California, Livermore). Nucl. Phys., B1: 613-47(1967). (UCRL-70231).**

The previously considered dynamical system consisting of neutral K and electromagnetic fields coupled through the interaction that determines the K^0 parity to be imaginary is studied, starting from general principles. In order to satisfy Lorentz invariance, the interaction is introduced by modifying the free-field equal-time commutation relations rather than by changing the form of the free-field Hamiltonian. The resulting field theory is essentially nonlinear in the sense that the Hamiltonian does not separate naturally into a free-field part and an interaction part. The field equations for the interacting system are derived by requiring the momentum operator to act as the generator of space-time translations. A limited discussion of the particle aspect of the theory is given. The concepts that originally motivated the assumed interaction are reviewed. (auth)

27331 RELATIVISTIC PARTIAL WAVE ANALYSIS OF ELECTRON SCATTERING. **Fischer, C. R.; Akerib, R. (City Univ. of New York). J. Math. Phys. (N. Y.), 8: 451-3(Mar. 1967).**

The partial wave series for the scattering amplitude for high-energy electron scattering is not uniformly convergent. The singularity responsible for the nonuniform convergence containing terms in $(\sin \frac{1}{2}\theta)^{2i\alpha-2}$, $(\sin \frac{1}{2}\theta)^{2i\alpha-1}$, and $(\sin \frac{1}{2}\theta)^{2i\alpha}$ is separated from the rest of the series so that an accurate partial wave analysis may be carried out for any scattering angle. (auth)

27332 MULTIPLE SCATTERING OF ELECTROMAGNETIC WAVES BY ARBITRARY CONFIGURATIONS. **Twersky, Victor (Sylvania Electronic Defense Labs., Mountain View, Calif.). J. Math. Phys. (N. Y.), 8: 589-610(Mar. 1967).**

The previous development of the scalar problems is extended to three-dimensional vector electromagnetic scattering problems. A vector-dyadic formalism that facilitates exploiting the previous results is introduced, and analogous integral equations which specify the multiple-scattering amplitudes for many objects in terms of the corresponding functions for isolated scatterers are derived. One representation is in terms of the dyadic analog of Beltrami's operator. For arbitrary configurations, the multi-scattered amplitudes are developed as series in inverse powers of the separations of scatterers (with coefficients in terms of isolated scatterer amplitudes and their derivatives); for two scatterers, a corresponding closed form in terms of a differential operator is derived. Another representation is a system of algebraic equations for the many-body multipole coefficients in terms of the isolated scatterer values. Explicit closed forms are derived for two arbitrarily spaced elementary scatterers (electric dipoles, magnetic dipoles, etc.) both by separations of variables, and by working with elementary dyadic fields. (auth)

27333 EFFECT OF HIGH-MASS CHANNELS ON ELECTROMAGNETIC MASS DIFFERENCES OF BARYONS AND VECTOR MESONS. **Lichard, Peter (Katedra Fyziky SVST, Bratislava);** Pisut, Jan. Nucl. Phys., B1: 511-20(1967).

Electromagnetic mass differences of baryons, baryon resonances and vector mesons are calculated with a simple quantal model. Baryons and baryon resonances are considered as SU(3) bound states in the baryon-pseudoscalar system. In the case of baryons, the channels consisting of baryon resonances and pseudo-scalar mesons are considered too. The correct signs and magnitudes of electromagnetic mass differences are obtained. On the other hand, when an SU(2) bound-state model is used and when only the effect of the lowest-lying channels is respected, the results disagree violently with experimental data. (auth)

27334 SUM RULES AND THE ELECTROMAGNETIC ISOBAR-NUCLEON CURRENT. **Bollini, C. G.; Giambiagi, J. J. (IAEA, Trieste, Italy. Fundacion Bariloche, Buenos Aires). Nuovo Cim. (10), 49A: 322-5(May 21, 1967). (IC-67/11).**

Modifications and corrections to a recent computation by Gasiorowicy (Phys. Rev., 146: 1071(1966)) of the isovector form factor from a sum rule are suggested. Instead of determining the constant from the multipoles of the photoproduction data, the well-established form factor is used to fix the current and its connection with the photoproduction amplitudes is then discussed. (L.B.S.)

27335 PHOTOPRODUCTION OF π^+ AND $N^* \rightarrow N\gamma$ MAGNETIC TRANSITION AMPLITUDE. Grilli, M. (CNEN, Frascati, Italy); Nigro, M.; Schiavuta, E. Nuovo Cim. (10), 49A: 326-32(May 21, 1967).

An attempt is made to evaluate the $N^* \rightarrow N\gamma$ transition magnetic moment from an analysis of the π^+ photoproduction data by linearly polarized γ rays, in the region of the P_{33} resonance. The treatment of Dalitz and Sutherland is followed, who described the magnetic dipole amplitude M_{1+}^{3} near the resonance with a Breit-Wigner formula. Since M_{1+}^{3} is proportional to μ^*, this constant is evaluated and found to be $(1.23 \pm 0.3)\ 2\sqrt{2}/5\ \mu_v$. The evaluation of μ^* agrees with that obtained from π^0 photoproduction data, and is compared with the SU(6) prediction $\mu^* = (2\sqrt{2}/5)\ \mu_v$. (L.B.S.)

27336 GAUGE INVARIANCE AND REGGE-POLE SUM RULES FOR PION PHOTOPRODUCTION. **Musto, R.; Nicodemi, F. (Syracuse Univ., N. Y.). Nuovo Cim. (10), 49A: 331-7 (May 21, 1967). (NYO-3399-104; SU-1206-104).**

It is shown that in the case of pion photoproduction the sets of sum rules which can be obtained from gauge invariance and from a Regge-pole model are not equivalent. The Regge-pole sum rules are further discussed. (L.B.S.)

27337 ELECTROMAGNETIC MASS SPLITTINGS OF BARYONS IN A BOSON-FERMION MODEL. **Lichtenberg, D. B. (Indiana Univ., Bloomington). Nuovo Cim. (10), 49A: 435-8(June 1, 1967).**

Electromagnetic mass splittings of the members of the baryon octet and decuplet are calculated with a model in which these baryons are bound states of a boson sextet and a fermion triplet. The ten baryon electromagnetic splittings are given in terms of four parameters, and thus six independent relations among the splittings are obtained. (auth)

27338 REMARKS ON THE SATURATION OF A SUPER-CONVERGENCE SUM RULE IN π^0 PHOTOPRODUCTION. Bietti, A. (Istituto Nazionale di Fisica Nucleare, Rome. Univ., Rome); Di Vecchia, P.; Drago, F. Nuovo Cim. (10), 49A: 511-15(June 1, 1967).

The superconvergence properties of an invariant amplitude of π^0 photoproduction are discussed. It is shown that, owing to the slow convergence of the sum rule, the approximate saturation by means of a few low-lying states seems rather doubtful. An attempt is made to saturate the sum rule using a phenomenological multipole analysis of π^0 photoproduction up to 1.8 GeV. The result was found to be off by 30%. It is suggested that additional contributions from higher resonances may well add up to satisfy the sum rule. (L.B.S.)

27339 LOW'S NON-MINIMAL INTERACTION AND HEAVY ELECTRONS. **Terazawa, Hidezumi (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 37: 204-5(Jan. 1967).**

It is shown that the previously determined upper limits for the production cross section and the value of the coupling strength for the heavy electron are not precise. (J.F.P.)

27340 ON THE ELECTROMAGNETIC STRUCTURE OF THE YUKAWA MESON. II. **Schiff, L. I. (Stanford Univ., Calif.). Progr. Theoret. Phys. (Kyoto), 37: 635-6(Mar. 1967).**

It is shown that the form or range of the cutoff has no effect on the result of the calculation of first order Coulomb field strength in the elastic scattering of strongly interacting charged particles. This work was performed in order to measure the electromagnetic form factor of the meson (π) through comparison of the elastic scattering of positive and negative mesons (π) on an isoscalar nucleus. (J.F.P.)

27341 UNSTABLE STATES WITH COMPLEX ANGULAR MOMENTUM IN QUANTUM ELECTRODYNAMICS. **Sannikov, S. S. (Inst. of Physics and Tech., Kharkov). Phys. Lett., 24A: 551-3(May 8, 1967).**

The physical consequences of introducing complex angular momentum to unstable states of quantum electrodynamics (atomic states and positronium) are considered. (auth)

Weak

27342 (JINR-P2-3251) RASSHCHEPLENIE TRAEKTORII REDZHE I SOOTNOSHENIYA MEZHDU SECHENIYAMI PRI VYSOKIKH ENERGIYAKH. **(Regge Trajectory Splitting and Relations Between High Energy Cross Sections). Kadyshevskii, V. G.; Mir-Kasimov, R. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1967. 11p. (In Russian). Dep.**

A number of relations are obtained between the cross sections for meson-nucleon and nucleon-nucleon collisions at high energies in the framework of a model unifying the Regge pole theory and the broken SU(3) symmetry scheme. (auth)

27343 (JPL-TR-32-1082) QUARK MODEL OF LEPTONS. Zmuidzinas, Jonas Stasys (Jet Propulsion Lab., Pasadena, Calif.). May 1, 1967. Contract NAS7-100. 14p.

A model is proposed in which leptons are deeply bound states of certain combinations of quarks and quirks (R-conjugates of quarks), as well as of their antiparticles. The mass splittings of the leptons are estimated using the static model with unitary-symmetric meson exchange forces and are found in rough agreement with experiment, provided one uses the quark mass differences implied by the quark model of hadrons. A new charged spin-½ lepton, $\lambda^\pm$, is predicted with mass $\gtrsim M_{\text{pion}}$. Weak interactions of known leptons and $\lambda^\pm$ are examined from the viewpoint of the model. The electromagnetic decay $\mu \to e + \gamma$ is strictly forbidden. Rough dynamical arguments are presented to explain why leptons should be devoid of strong interactions. (auth)

27344 SOME CONSEQUENCES OF THE KINETIC MOMENTA CONSERVATION FOR THE INTERACTION BETWEEN FOUR FERMIONS. Gabos, Z. Stud. Univ. Babes-Bolyai, Ser. Math.-Phys., 11: No. 2, 131-6(1966). (In Rumanian).

Using as basic bispinors the proper function common to the operators $\bar{\Sigma}^2$, Σ_3, γ_5 some results are found regarding the coupling of kinetic momenta in the case of the interactions between four fermions. The obtained results are applied to the study of β^- disintegration of the neutrons with the spin directed. (auth)

27345 NOTE ON THE β DECAY OF Σ PARTICLES. Maekawa, Takayoshi (Kumamoto Univ., Japan). Kumamoto J. Sci., Ser. A, 7: 13-15(May 1965).

Experimental results on the β decay of the Σ particle are discussed. The observed decay rates are about 60 times smaller than those expected by the conserved vector current theory of Feynman and Gell-Mann. A model of the violation of the full symmetry is discussed, and the strangeness-changing β decay of Σ particles was analyzed according to this model and the results compared with those of the conserved vector current theory. When the Σ particle is assigned to Σ_1 or Σ_2 particles and the decay rate of the strangeness-conserving β decay of the Σ particle calculated, smaller values than the experimental values were obtained. Σ_1 and Σ_2 are composite particles with the same isospin and strangeness as Σ particles, and are, respectively, symmetric and antisymmetric in relation to the constituent basic particles in the full symmetry theory. These processes may occur through the universal weak interaction. It is concluded that the decay rate of the strange particles depends on the difference of the strangeness between the initial and final states. That is, the coupling strength of the strangeness-changing weak interaction is smaller than that of the strangeness-conserving weak interaction. (BBB)

27346 NEUTRINO FIELD IN GENERAL RELATIVITY. **Moret-Bailly, Francoise (Faculte des Sciences, Dijon, France). Ann. Inst. Henri Poincare, Sect. A, 5: 301-55(1966). (In French).**

A spinor theory of neutrinos is studied within the framework of general relativity from the classical and then quantum viewpoints. The fusion of a neutrino and an antineutrino so as to construct a photon and more generally of four neutrinos in order to obtain a field of spin 2 is also realized. The neutrino theory developed is not reduced even in the case of limited relativity to the Yang and Lee theory. From the spinor theory of the neutrino developed the fusion method furnishes a theory in spinor formalism of the photon and of the field of spin 2. First the spinors in general relativity are considered on a space-time curve. The theory of the classical Dirac field on any space-time curve is reviewed. A complete study is made of the fields of tensors associated with a field of 1-spinors. A particular solution of the problem of permanence of the singular Dirac field is given in the case of limited relativity. The theory of the neutrino field considered as a Dirac field without mass term is then given. A fusion method is developed by exploiting the classical correspondence between the exterior forms and the second order spinors. (J.S.R.)

27347 SU_3 AND HYPERON DECAYS. **Nath, L. M.; Dhar, S. D. (Atomic Energy Center, Dacca, Pakistan). Nuovo Cim. (10), 49A: 459-66(June 1, 1967). (AECK-TP-19).**

Assuming that the vector part of the weak current is a member of the F-type octet and the axial vector current is an admixture of F-type octet, D-type octet and the 27-dimensional current in SU_3, the branching ratios for the semi-leptonic decays and the asymmetry parameters for the nonleptonic decays of hyperons were calculated on the basis of the current-current form and octet enhancement of the effective interaction. The Lee-Sugawara triangle relation and other empirical relations in nonleptonic hyperon decays come out as consequences of the assumptions made above. For the semi-leptonic decays theoretical expectations are consistent with the present experimental data. (auth)

27348 $|\Delta I| = 1/2$ RULE AND $K \to 2\pi$ DECAYS. Hara, Yasuo (Tokyo Univ. of Education). Progr. Theoret. Phys. (Kyoto), 37: 470-1(Feb. 1967).

The possibility is shown that the rather large branching ratio $\Gamma(K^+ \to 2\pi)/\Gamma(K_1^0 \to 2\pi)$ may be due to the electromagnetic correction to the interaction $H_w = G\bar{q}(\lambda_6 \pm \gamma_5\gamma_7)\ q = H_w^{(6)+} \pm H_w^{(7)}$, which satisfies the $|\Delta I| = 1/2$ rule is shown. (J.F.P.)

27349 ROLE OF SCALAR- AND PSEUDOSCALAR-DENSITIES IN NONLEPTONIC DECAYS OF HADRONS. **II. S-WAVE MESON-**

BARYON INTERACTION. Fujii, Kanjii; Terazawa, Osamu (Hokkaido Univ., Sapporo). Progr. Theoret. Phys. (Kyoto), 37: 207-9 (Jan. 1967).

Results obtained using a previously proposed theory for nonleptonic decays of hadrons are reported. This theory which is used refines the pole approximation model and establishes interrelations for some previous attempts. (J.F.P.)

27350 PROPOSAL OF NEUTRINO EQUATION. Tokuoka, Zensuke (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 37: 603-17(Mar. 1967).

A new wave equation of a neutrino, which is a natural counterpart of the electromagnetic equation, is proposed. Though the ordinary two-component neutrino equation is itself P- and C-invariant, the new equation is not invariant against parity and charge conjugation separately but is CP-invariant. The accepted V-A interaction is explained as a potential interaction of the neutrino. The field is quantized only by generalizing the Hilbert space. (auth)

27351 ROLE OF SCALAR- AND PSEUDOSCALAR-DENSITIES IN NONLEPTONIC DECAYS OF HADRONS. I. Fujii, Kanji; Terazawa, Osamu (Hokkaido Univ., Sapporo). Progr. Theoret. Phys. (Kyoto), 37: 205-7(Jan. 1967).

A theory of nonleptonic decays which refines the pole approximation model and establishes interrelations for some previous attempts is proposed. (J.F.P.)

27352 PHOTONIC DECAY OF HYPERONS AND SUZUKI-SUGAWARA HAMILTONIAN. Iwao, S. (Univ., Bern). Helv. Phys. Acta, 40: 230-6(1967).

Suzuki-Sugawara Hamiltonian of the weak hadronic decay is tested by the two-body photonic decay of hyperons. The S-matrix element of the photonic decay of hadrons associated with the weak interaction is proved to be proportional to the equal-time commutator of the weak Hamiltonian and electromagnetic current in a proper approximation. The weak axial parameters are adjusted to those obtained from the semi-leptonic decay of hyperons while those for the magnetic form factors of the electromagnetic interaction are adjusted to the SU(6) result. Including the neutral weak currents the relative decay rate of $\Sigma^+ \rightarrow p\gamma$ to its total rate is found to be 2.7 (10^{-4}) which is comparable with the experimental (3.7 ± 0.8) (10^{-4}). The decay asymmetry parameter α for the longitudinal polarization is given by $\alpha = 0.14$. The corresponding study was made for five unobserved decays. (auth)

Strong (General)

27353 (UCRL-17483) STRONG INTERACTIONS AND THE 200 GeV ACCELERATOR. Chew, Geoffrey F. (California Univ., Berkeley. Lawrence Radiation Lab.). Mar. 29, 1967. Contract W-7405-eng-48. 19p. Dep. CFSTI.

The discussion of strong interactions and the 200-GeV accelerator includes a brief survey of the existing state of knowledge, and some arguments that the contemplated increase of energy will be of qualitative value to the internal development of a strong interaction theory. (J.F.P.)

27354 GRAPHICAL METHOD FOR MULTI-SOFT-PION PROCESSES. Abarbanel, Henry D. I.; Nussinov, Shmuel (Princeton Univ., N. J.). Ann. Phys. (N. Y.), 42: 467-75(May 1967).

A set of graphical rules is established for writing down all the contributions to the hadron process $\alpha \rightarrow \beta + n$ soft pions dictated by the algebra of current commutators of Gell-Mann and PCAC. Explicit results are given for $n = 3$. An example of $n = 4$ is treated in the form of soft π-π scattering, where the small s-wave scattering lengths found by Weinberg are rederived. (auth)

27355 HADRON SCATTERING AND QUARK MODELS. Oakes, R. J. (CERN, Geneva). Nuovo Cim. (10), 49A: 316-18(May 21, 1967).

A simple quark model is pointed out which is different from that in which the additivity assumption is applied to the two-body quark-quark and quark-antiquark scattering amplitudes, and which also yields several relations among cross sections that are in remarkable agreement with the data over the energy range of 6 to 20 GeV/c. The model is based on the hypothesis that the only significant net interaction among systems of quarks occurs when their total charge is integral. The additivity assumption is therefore applied to the quark-antiquark and three-quark interaction. (L.B.S.)

27356 REGGE MODEL FOR HIGH-ENERGY COLLISIONS PRODUCING THREE FINAL PARTICLES. Chan, Hong-mo; Kajantie, K.; Ranft, G. (CERN, Geneva). Nuovo Cim. (10), 49A: 157-82(May 1, 1967).

A double Regge model is applied to hadron production processes with three final particles at high energy. Some important properties of double Regge graphs are noted which simplify the problem sufficiently for realistic calculations to be made. A preliminary comparison of the predictions of the model with the experimental distributions on the Dalitz plot for two CERN experiments at 8 GeV/c and at 7 and 12 GeV/c is favorable. The model makes in addition several clear predictions available to experimental tests, and is sufficiently general to form the basis of a systematic analysis of three-particle data. (auth)

27357 SYMMETRY AND REGGE POLES FOR HIGH-ENERGY INELASTIC TWO-BODY REACTIONS. Borgese, A. (Univ., Florence); Buccella, F.; Colocci, M.; Celeghini, E. Nuovo Cim. (10), 49A: 199-205(May 1, 1967).

The inelastic two-body processes $M + B \rightarrow M + B$, $M + B \rightarrow M + B^*$, $M + B \rightarrow V + B$ and $M + B \rightarrow V + B^*$ are studied. The main hypothesis used in the Regge parametrization of high energy amplitudes with the usual assumptions on the isospin properties. Results previously obtained in some treatments of the quark model are recovered, and further restrictions on the cross sections are gained from the hypothesis of degeneracy for the two trajectories with opposite signature. The absence of interference between contributions from trajectories having opposite signature, which is a consequence of charge degeneracy, is a feature peculiar to this approach. Finally, a comparison with experimental data shows satisfactory agreement. (J.F.P.)

27358 MASS SPLITTING AMONG BARYONS IN GROUND STATES. INTRODUCTION OF ISOSPIN DEPENDENT FORCE. Nagai, Hideaki; Okada, Kunihiko (Hiroshima Univ.). Progr. Theoret. Phys. (Kyoto), 37: 210-12(Jan. 1967).

The observed mass splitting among baryons in ground states (octet and decuplet) is reproduced by adding two assumptions to a previous model. These assumptions are that q_3 have mass excess compared to q_1, and q_2, and the spin independent symmetry breaking potentials exist, and besides the spin-spin force, the isospin-dependent force exists at $f_T(r)\Sigma^n_{i>j}T_i \cdot T_j$, where $T_i = 1/2\begin{pmatrix}\tau 0 \\ 0 0_i\end{pmatrix}$ and i means a number given for constituting particles (quarks) in the composite system. (J.F.P.)

Strong (Baryon No. = 0)

Refer also to abstract 27383.

27359 EFFECT OF HIGHER πN RESONANCES TO SUBTRACTION CONSTANT IN THE $\pi\pi \rightarrow N\bar{N}$ DISPERSION RELATION. Furuichi, Susumu (Rikkyo Univ., Tokyo); Watanabe, Keiji. Progr. Theoret. Phys. (Kyoto), 37: 465-7(Feb. 1967).

From a study made of the contribution from higher πN resonances on the subtraction constant in the $\pi + \pi \rightarrow N + \bar{N}$ dispersion relation it is found that the contribution from higher resonances can be inferred as small and negative. (J.F.P.)

27360 ON $\bar{p}$n ANNIHILATION BY THE QUARK REARRANGEMENT MODEL. Hayashi, Masaki (Jagiellonian Univ., Krakow). Progr. Theoret. Phys. (Kyoto), 37: 467-9(Feb. 1967).

The predicted distribution of final states for $\bar{p}$n annihilation at rest by the quark rearrangement model assuming the ratio of the total triplet annihilation rate to the total singlet annihilation rate to be 3 : 1 is presented. Assuming a statistical distribution of the triplet and singlet spin states one obtains $n_{ch} = 2.5$. (J.F.P.)

27361 SUPERCONVERGENCE SUM RULES IN $\rho\pi$ SCATTERING. Frampton, P. H.; Taylor, J. C. (Oxford Univ.). Nuovo Cim. (10), 49A: 152-6(May 1, 1967).

The contributions of the A_1 and A_2 resonances to a set of six superconvergence sum rules in $\rho\pi$ scattering are calculated. The π, ω and A_1 terms go a good way towards saturation of the forward sum rules, and the A_2 terms are rather small. The A_2 contributions to the nonforward sum rules are larger, and two of them are still far from saturation. (auth)

27362 ALGEBRA OF CURRENTS AND $\omega-\phi$ MIXING ANGLE. Khanna, M. P.; Vaidya, A. (International Atomic Energy Agency, Trieste, Italy). Nuovo Cim. (10), 49A: 341-7(June 1, 1967).

The equal-time commutation relations of integrated currents to the $\omega-\varphi$ system. In particular the value of the $\omega-\varphi$ mixing angle is deduced. Use is also made of some of the results derived to test the models of elementary particles as proposed by Okubo, showing that the Gell-Mann-Zweig quark model is more favorable than the Maki-Hara quark model. (auth)

27363 INCOMPATIBILITY OF A SUPERCONVERGENCE RELATION WITH CONSERVATION OF A PARITY. Vasavada, K. V. (Univ. of Connecticut, Storrs). Nuovo Cim. (10), 49A: 499-503(June 1, 1967).

The validity of a superconvergence relation for forward scattering of the $K^*(1^-)$-π system, which leads to information on coupling constants, is investigated. Higher meson resonances in addition to the pseudoscalar and vector meson intermediate states are considered to saturate the superconvergence relation. It is concluded that unless there are strong contributions from the non-resonant background terms, the present superconvergent relation is incompatible with conservation of A-parity. (L.B.S.)

27364 SYMMETRIES OF QUARK–ANTIQUARK SCATTERING AND MESON MASS-SPLITTING. **Stern, J.; Vancura, A. (Faculty of Technical and Nuclear Physics, Prague). Nuovo Cim. (10), 49A: 51-60(May 1, 1967).**

Linear mass formulas for meson nonets are obtained. The derivation is based on equalities among partial wave amplitudes for quark-antiquark scattering obtained previously and on an assumption about their analytical properties. The resulting formulas are in very good agreement with experimental mass values for the 1^- and 2^+ meson nonets, but fail completely for pseudoscalar mesons. (auth)

27365 LOW-ENERGY BEHAVIORS OF THE T = 0, S-Wave, $\pi-\pi$ SCATTERING PHASE SHIFT AND A POSSIBLE SCALAR MESON NONET. Yabuki, Haruichi (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 37: 419-24(Feb. 1967).

All the possible low-energy behaviors of the T = 0, S-wave $\pi-\pi$ phase shift $\delta(k)$ are investigated using the effective range formula. It is found that there exists a case satisfying the conditions (1) that the phase shift $\delta(k)$ rises through $\pi/2$ at about the ρ-meson mass without any appreciable bump in the cross section around this point and (2) that the scattering length is small, say $0.5m^{-1}$ or smaller. The values of the scattering length a and the effective range r are severly restricted by the above two conditions (1) and (2), that is, $a \approx -r \approx 0.5m^{-1}$, which is compatible with the recent result of Weinberg both in sign and in magnitude. If a broad enhancement in the lower energy region is allowed or if a larger value for the position of the phase shift passing through $\pi/2$, is taken then a smaller scattering length is obtained. A possible scalar meson nonet associated with this phenomenon is proposed. (auth)

27366 DIFFICULTY IN THE NON-RELATIVISTIC TREATMENT OF THE COMPOSITE MODEL OF ELEMENTARY PARTICLES. **Nagasaki, Masayuki (Rikkyo Univ., Tokyo). Progr. Theoret. Phys. (Kyoto), 37: 437-51(Feb. 1967).**

In order to see the validity of the nonrelativistic treatment used in the current works on the composite model of elementary particles, the system of a Dirac particle and an anti-particle bound in the $^1S_0$ state through a potential is analyzed. It is shown that the potential strength should tend to infinity when the total energy of the system approaches to zero if their masses are equal or the total energy of the system approaches to the difference between their masses if they are not equal. The type of the interaction is found to be restricted to (V−A) and [(S + P)/2−T] by the conditions for getting physically acceptable solutions. Discussion is given also for some aspect of the composite system of three urbaryons. (auth)

27367 COUPLING CONSTANTS OF THE ONE-BOSON EXCHANGE MODEL. **Sawada, S. (Nagoya Univ., Japan); Ueda, T.; Watari, W.; Yonezawa, M. Nuovo Cim. (10), 49A: 319-21 (May 21, 1967).**

The masses and coupling constants of the isoscalar-scalar meson obtained from various works in the one-boson-exchange model are summarized. (L.B.S.)

Strong (Baryon No. = 1)

Refer also to abstracts 27316 and 27629.

27368 (JINR–P2-3254) VZAIMODEISTVIE TOK x TOK I POLYUSNAYA MODEL' NELEPTONNYKH RASPADOV GIPERONOV. **(Current x Current Interaction and the Pole Model of Non-Leptonic Hyperon Decays). Niri, Yu.; Struminskii, B. V.; Tavkhelidze, A. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1967. 7p. (In Russian). Dep.**

The pole model of parity violating nonleptonic hyperon decays is considered. On the basis of a current x current Hamiltonian the absolute values of decay amplitudes are calculated and the dynamical mechanism of the appearance of the $\Delta T = 1/2$ selection rule is suggested. (auth)

27369 ZERO MASS PIONS. **Hamilton, J. (NORDITA, Copenhagen). Nucl. Phys., B1: 449-70(1967).**

By using the concept of external pions of zero mass in pion-nucleon scattering graphs, it is possible to develop a gage principle which directly gives two of the results of current-current commutator and PCAC techniques for low energy πN scattering. The gage principle also makes it possible to study the nature of the phenomenological interactions of zero-mass pions with a nucleon, and this leads to the Adler-Weisberger sum rule and the ρ-meson coupling constant relation. (auth)

27370 METHOD OF BACKGROUND ESTIMATION IN INVARIANT-MASS DISTRIBUTIONS DUE TO HIGHER RESONANCES. **Nagy, E. (Joint Inst. of Nuclear Research, Dubna, USSR. CERN, Geneva). Nuovo Cim. (10), 49A: 280-4(May 21, 1967).**

A method is given for estimating background in invariant-mass distributions due to particles produced in the decay chain of heavy resonances. As an illustration, a few examples are calculated, which were considered as possible background in an experiment designed to study the $\Lambda\gamma$ mass spectrum. (auth)

27371 EIGENVALUE PROBLEM FOR THE π-$\mathcal{N}$ PARTIAL WAVES. Jones, R. B. (Univ. of London). Nuovo Cim. (10), 49A: 108-35(May 1, 1967).

Models of π-$\mathcal{N}$ scattering based on partial-wave dispersion relations, elastic unitarity and single-particle exchange forces are considered. Using the N/D method and working in the variable $W = \sqrt{S}$, it is shown how the unitarity integral in the D equation can be done explicitly in terms of simple functions, thus obtaining an easy method of continuing the amplitude off the physical sheet through its elastic unitarity cuts. Using a pole approximation to the left-hand cuts, it is shown that the N/D solution for such models can be cast into an eigenvalue problem for an unsymmetric real matrix. The relevance of this method of solution for simple reciprocal bootstrap calculations and for the problem of determining the convergence of iterative approximations to the exact N/D solution is pointed out. Finally, the qualitative results of a numerical study of the eigenvalue problem for a simple reciprocal bootstrap model are reported. (auth)

27372 MASS LEVELS AND DECAY PROBABILITIES OF NUCLEON RESONANCES. AN ANALYSIS BASED ON THE INDEPENDENT PARTICLE LIKE MODEL. **Nagai, Hideaki (Hiroshima Univ.). Progr. Theoret. Phys. (Kyoto), 37: 425-36(Feb. 1967).**

It has been shown that the presently known data on baryons (isospin, spin, parity, and mass) can be understood fairly well by the composite model of three fundamental triplets (fermions) of SU_3 under a certain number of simple assumptions. From the same point of view as previous the following results are obtained: By assuming that three fundamental fermions in the baryon behave nonrelativistically as independent particles in the effective mean potential (square well like) with the depth ~10 BeV, the potential range (~1 BeV^{-1}) is determined and energy levels of nucleon resonances are obtained. A slightly modified square well potential leads to excellent agreement with observed mass levels of nucleon resonances. Decay probabilities of $N^* \to N + \pi$ processes are obtained by taking account of the effect of the model from the point interaction Lagrangian among the N_j^*, N, and π fields. As a result two universal coupling constants corresponding to resonances with the different intrinsic spin connected with a relation $g_{1/2}^2 = 20\, g_{3/2}^2$ are determined. It is shown that the observation of 2s-, 2p-, and 2d-levels suggested from the model is difficult. In order to estimate the effect of the model, as an extreme case, calculation of $N^* \to N + \pi$ decay probabilities is carried out by using a method similar to a multipole transition from the nucleus. (auth)

27373 LONG RANGE INTERACTION IN LOW ENERGY K–N SCATTERING. **Ino, Taketoshi (Hiroshima Univ.). Progr. Theoret. Phys. (Kyoto), 37: 398-418(Feb. 1967).**

Differential K^+-p and K^+-d cross sections up to 642 MeV/c are analyzed under the assumption that the long range part of the interaction is given by the exchange of low-lying particles and the long-range interaction dominates in the states with the total angular momentum $j \geqq 3/2$, while the scattering amplitudes of the $s_{1/2}$ and $p_{1/2}$ states, to which the short range interaction is considered to give an important contribution, are treated as free parameters. Contributions from Λ, Σ, Y_1^*(1385 MeV), Y_0^*(1405 MeV), Y_0^*(1520 MeV), Y_1^*(1660 MeV), an iso-singlet scalar meson (400 ~ 1000 MeV), ρ, ω, and ϕ are taken into account. Differently from a similar analysis given by Warnock and Frye, emphasis is here put on the higher angular momentum states. Two types of solutions which well reproduce the experimental data are found, one giving the Fermi-type I = 0 phase shifts and the other the Yang-type I = 0 ones. Contributions from the higher partial waves ($l \geqq 3$) are estimated and found not negligible for the I = 0 state at high energies. The coupling constants which give the Yang-type I = 0 phase shifts are consistent with other analyses and the predictions of the SU(3) symmetry, while those giving the Fermi-type I = 0 phase shifts are not. The possibility that the isotropic character of the K^+-p differential cross section is not due to the dominant s-wave scattering is also examined. (auth)

27374 QUARK-MODEL CALCULATION OF THE Λ TO Σ RATIO IN THE ISOSPIN-1 s-WAVE $\bar{K}$N REACTION. **Morpurgo, G. (Univ., Genoa. Istituto Nazionale di Fisica Nucleare, Genoa). Phys. Rev. Lett., 18: 936-8(May 22, 1967).**

It is shown that the ratio between the amplitudes of the reactions $\bar{K}_0 + p \to \Lambda + \pi^+$ and $\bar{K}_0 + p \to \Sigma^0 + \pi^+$ in the s-wave region can be calculated by the quark model under the assumption that no nearby J = $1/2^-$ resonance exists affecting these amplitudes. The parameter $E_{(s\ wave)}$ is shown to be 0.67 and is larger than this if, in addition, p waves are included. The experimental value is 0.35 ± 0.03. (auth)

27375 ENERGY SPECTRUM OF NUCLEON ISOBARS IN STRONG COUPLING MESON THEORY. **Wakano, Masami (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 37: 558-70(Mar. 1967).**

With the large cutoff the energy spectrum of isobar states of nucleons with y = 0, where the operator Y^i is defined by $Y^i = L^i_0 + T^i_0$, is obtained by taking into due account the quantum-mechanical effect. The newly discovered resonance ($T = 1/2$, $J^P = 1/2^+$) with mass 1480 MeV in the pion–nucleon scattering process is explained as the first excited vibrational state. Since the isobar energies are not completely degenerate with respect to the quantum numbers of rotational motions in the strong coupling limit, the derivation of the "isobar energy condition" for the mass operator in the Cook, Goebel and Sakita work would have to be modified in its exact sense when one applies their procedure to the strong coupling theory with the Pauli-Dancoff representation. The nature of solutions with y = 1 is very sensitive to the boundary condition to be applied, and it is shown that these states vanish. This will be an explanation of the reason why there is no evidence for low-lying resonance with $T = 1/2$, $J^P = 3/2^+$ or $T = 3/2$, $J^P = 1/2^+$ in the pion–nucleon scattering process. (auth)

27376 KINEMATIC CORRECTIONS TO REGGE-POLE ANALYSIS OF $\pi^- + p$ yields $\eta^0 + n$. **Phillips, R. J. N. (Atomic Energy Research Establishment, Harwell, Eng.). Nucl. Phys., B1: 572-6(1967).**

It is shown that kinematic corrections, coming from the $\eta-\pi$ mass difference, make little difference to previous analyses using the A_2 Regge pole. (auth)

27377 DECAY RATES OF $Y_0^*(1520)$ AND ITS SU(3) CLASSIFICATION. **Yodh, G. B. (Univ. of Arizona, Tucson). Phys. Rev. Lett., 18: 810-12(May 8, 1967).**

Available data for the reaction $K^- + p \rightarrow Y_1^*(1765) \rightarrow Y_0^*(1520) + \pi$ are studied to obtain rates for $Y_0^*(1520)$ decaying into $\bar{K}N$, $\Sigma\pi$, and $\Lambda\pi\pi$ channels. The weighted average of all determinations of the ratio of squares of the reduced matrix elements for $\Sigma\pi$ and $N\bar{K}$ modes is found to have a value incompatible with the assumption that $Y_0^*(1520)$ is a pure SU(3) singlet. Therefore, either Y_0^* (1520) is likely to be mixed with a $3/2^-$ octet or unbroken SU(3) branching ratio predictions are unreliable or difficult to compare with experiment. (auth)

27378 NEW SUM RULES FOR SUPERCONVERGENCE. **Gatto, R. (Univ., Florence. Istituto Nazionale di Fisica Nucleare, Florence). Phys. Rev. Lett., 18: 803-6(May 8, 1967).**

A new sum rule for the pion-scattering amplitude $B^+(\nu,t)$ is derived from a superconvergence assumption and its saturation is discussed. A similar sum rule for the amplitude $F^-(\nu,t)$ is also obtained and its consequences are examined. (auth)

27379 EVIDENCE FOR AN S = +1, I = 0 RESONANCE IN THE K^+-NUCLEON SYSTEM. Carter, A. A. (Cambridge Univ., Eng.). Phys. Lett., 18: 801-3(May 8, 1967).

The phase of the K^+-nucleon forward-scattering amplitude was evaluated from dispersion relations and a qualitative difference was found between the I = 0 and I = 1 state. With assumptions for the background contributions to the amplitude, evidence is presented for an S = +1, I = 0 resonance. (auth)

27380 CRITIQUE OF REGGE-POLES INTERPRETATION OF BACKWARD π^-p ELASTIC SCATTERING. **Dikmen, F. Ned (Univ. of Michigan, Ann Arbor). Phys. Rev. Lett., 18: 798-800 (May 8, 1967).**

In recent work, fits to certain elastic pion-nucleon data were obtained by adding a resonance amplitude and Regge-trajectory exchange amplitude. It is shown that the s-channel resonance amplitude considered in this recent work is, by itself, satisfactory to explain the backward π^- scattering; i.e., it is shown that the need for a baryon-trajectory exchange amplitude is not established. (auth)

27381 MASS EMPIRICS. **Schwinger, Julian (Harvard Univ., Cambridge, Mass.). Phys. Rev. Lett., 18: 797(May 8, 1967).**

An empirical observation about the mass spectra of the baryon octuplet and the baryon resonance decuplet is made: The respective fractional mass splittings are found to be identical. The precise meaning of this statement refers to a particular phenomenological description of the mass spectra. The various particles are represented by fields (or sources, or state vectors) that are constructed from the third-rank unitary tensor. The decuplet is associated with a totally symmetrical tensor, and the octuplet is contained in a given matrix. (J.F.P.)

Strong (Baryon No. ≥ 2)

27382 AN IMPACT PARAMETER CUT-OFF MODEL FOR NUCLEON ISOBAR EXCITATION IN INELASTIC pp SCATTERING. **Rotsstein, A. (McGill Univ., Montreal). Nucl. Phys., B1: 655-67(1967).**

A simple model is presented to account for the energy and momentum transfer dependence, at small scattering angles, of the production differential cross sections in the reactions $p + p \rightarrow N + N^*$. N is a nucleon and N^* represents a nucleon isobar. The study is applied to the isospin $T = 3/2$ isobar at 1238 MeV and to the $T = 1/2$ isobars at 1400, 1512, 1688, and 2190 MeV respectively. Partial waves below an impact parameter cut-off b_c are suppressed, while for $b > b_c$ the partial waves are given by the Born one-pion exchange contribution for the 1238-MeV isobar and by a Gaussian distribution with a radius characteristic of elastic pp scattering for the $T = 1/2$ isobars. The results of the calculations are in good agreement with the data. (auth)

27383 NUCLEON–NUCLEON AND NUCLEON–ANTINUCLEON ELASTIC SCATTERING AT HIGH MOMENTUM TRANSFERS. **Bialas, A. (Jagellonian Univ., Krakow. CERN, Geneva); Czyzewski, O. Nuovo Cim. (10), 49A: 273-9(May 21, 1967).**

The discussion of the present data on $\bar{p}p$ and np elastic scattering at high momentum transfers is given. It is shown that (i) the Orear formula can be used for the description of these data, (ii) the data are in disagreement with the statistical model of compound elastic scattering, (iii) the data suggest that the elastic interaction of nucleons and antinucleons at high momentum transfers is roughly independent of the kind of particles involved. (auth)

27384 METHOD FOR SOLVING THE NAMBU–SALPETER–BETHE EQUATION AND ITS APPLICATION TO NUCLEON–NUCLEON SCATTERING IN THE $^3P_1$ STATE. **Ito, Hitoshi (Kinki Univ., Osaka); Mizouchi, Masayoshi; Murota, Toshiyuki; Nakano, Tadao; Noda, MatuTarow; Tanaka, Fujio. Progr. Theoret. Phys. (Kyoto), 37: 372-97(Feb. 1967).**

A method for numerically solving the Nambu–Salpeter–Bethe equation in realistic cases is investigated. The method is based on a variational principle and can be applied to all energy regions. By this method the $^3P_1$ phase shifts in nucleon–nucleon scattering at 10, 100, 205, and 270 MeV incident energies are calculated in the ladder approximation of PS(PS) coupling. Information on the accuracy of solutions is also obtained. The numerical solutions in the case of neglecting the virtual nucleon pair effects are close to the results of the 3-dimensional nonstatic calculation with the one-pion-exchange potential. It is shown that nucleon pair effects are not large. (auth)

27385 NOTE ON THE BACKWARD PEAK IN ELASTIC PROCESSES ON DEUTERONS. **Chahoud, J. N. (Istituto Nazionale di Fisica Nucleare, Bologna); Russo, G. Nuovo Cim. (10), 49A: 206-8(May 1, 1967).**

It is emphasized that in the dispersive version of the impulse approximation for elastic processes on deuterons it is not likely that the single scattering contribution is overwhelmed by the multiple scattering contributions. In fact the whole model is based on the calculation of the single scattering graph taking into account only the contribution from the nearest anomalous branch cut in the t channel. (J.F.P.)

27386 BUBBLE CHAMBER STUDY OF PROTON–PROTON INTERACTIONS AT 4 GeV/c. Part I. ELASTIC SCATTERING, SINGLE-PION, AND DEUTERON PRODUCTION. **Coletti, S. (Univ., Milan. Istituto Nazionale di Fisica Nucleare, Milan); Kidd, J.; Mandelli, L.; (and others). Nuovo Cim. (10), 49A: 479-98(June 1, 1967).**

Elastic scattering, single-pion and deuteron production were investigated. The cross section for elastic scattering is $\sigma_{elastic}$ = (13.5 ± 0.3) mb. The angular distribution was fitted to $d\sigma/d|t| = (d\sigma/d|t|)_0\, e^{-bt}$ in the region of low values of t. The best fit gives $b = (6.7 \pm 0.5)\ (GeV/c)^{-2}$ and $(d\sigma/d|t|)_0 = (91 \pm 5)$ mb $(GeV/c)^{-2}$. The cross sections for $pp\pi^0$, $pn\pi^+$ reactions are respectively (2.6 ± 0.3) mb and (9.7 ± 0.4) mb. These reactions are dominated by the ($3/2$, $3/2$) nucleon-pion isobar production and by forward backward collimation of the nucleons. The production rates for the isobars $\mathcal{N}^{*++}_{1238}$, $\mathcal{N}^{*+}_{1238}$, $\mathcal{N}^{*+}_{1500}$ were estimated, taking into account the experimental peripheral behavior of the interaction. In the $pn\pi^+$ reaction they are (50 ± 2)%; (10 ± 3)%; (4 ± 3)%. In the $pp\pi^0$ reaction the production of $\mathcal{N}^{*+}_{1238}$ is estimated to be (45 ± 10)%. The $d\pi^+$ and $d\pi^+\pi^+\pi^-$ reaction cross sections are respectively (0.03 ± 0.01) mb, and (0.04 ± 0.01) mb. (auth)

27387 TWO-PION-EXCHANGE POTENTIAL WITH NUCLEON-PAIR EFFECTS. **Hiroshige, Noboru (Hiroshima Univ.). Progr. Theoret. Phys. (Kyoto), 37: 75-87(Jan. 1967).**

Two-pion exchange potentials with nucleon pair effects are calculated by taking full recoil into account. It is shown that a strong LS potential of the order of magnitude indicated by experiment can be obtained if consideration is taken of nucleon pairs in the intermediate state. (auth)

27388 BREMSSTRAHLUNG OF SOFT γ QUANTA IN $p + p \rightarrow p + p + \gamma$ AND $\pi^- + p \rightarrow \pi^0 + n + \gamma$ REACTIONS. Starodubtsev, G. P.; Shekhter, L. Sh. (Saratov State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz., No. 3, 146-50(1966). (In Russian).

The Low theorem for soft γ-quantum emission was applied to the reactions $p + p \rightarrow p + p + \gamma$ and $\pi^- + p \rightarrow \pi^0 + n + \gamma$. The first two terms of differential cross section expansion in the processes by photon energies (for the proton scattering at ultrarelativistic threshold) were obtained. (tr-auth)

Particle Invariance Principles and Symmetries

General

27389 CONNECTION OF INTERNAL AND RELATIVISTIC SYMMETRIES AND DYNAMICS IN THE UNDERLYING SPINOR SPACE. Mozrzymas, J. (Univ. of Wroclaw); Rzewuski, Jan. Acta Phys. Pol., 31: 479-85(Mar. 1967).

The geometric connection between the internal and the relativistic symmetries is discussed. The dynamics in the underlying spaces is investigated also for the following internal symmetries: SL (2, C), $SU(2)_I$ and SU(n). (auth)

27390 ISOPARITY AND SIMPLE LIE GROUP. Tanabe, Kosai (Saitama Univ., Urawa, Japan); Shima, Kazuhisa. J. Math. Phys. (N.Y.), 8: 657-62(Mar. 1967).

The direct generalization of the isoparity (or G-parity), with the defining property that it is commutable with the referring internal symmetry group, is investigated on the basis of the theory of Lie algebra. This is one special problem of the group extension of a simple Lie group by an involution. It is shown that the isoparity of this type can be defined for the simple Lie groups $SU(2)(A_1$ type), $SO(2l + 1)(B_l, l \geq 2)$, $Sp(2l)(C_l, l \geq 2)$, $SO(2l)(D_l, l \geq 3)$, G_2, F_4, E_7, and E_8, but not for the $SU(l + 1)(A_l, l \geq 2)$. The relation between the inner automorphism group and the Weyl group of the simple Lie algebra concerned is available to construct the isoparity operator explicitly. Some illustrative examples are presented. (auth)

27391 RELATIONSHIP OF THE INTERNAL AND EXTERNAL MULTIPLICITY STRUCTURE OF COMPACT SIMPLE LIE GROUPS. Macfarlane, A. J.; O'Raifeartaigh, L.; Rao, P. S. (Syracuse Univ., N. Y.). Contract AT(30-1)-3399. J. Math. Phys. (N. Y.), 8: 536-46(Mar. 1967). (NYO-3399-51).

As a preliminary step in a program aimed at developing the Racah algebra of an arbitrary compact simple Lie group L, a unified review with various extensions of the work of Biedenharn, Speiser, and others on the relation between the internal and external multiplicity structures of L, the former being that of the weights of the representations of L, the latter being that of the terms of the Clebsch–Gordan series of L is given. (auth)

27392 NEW CHARACTERIZATION OF THE RAY REPRESENTATIONS OF THE GALILEI GROUP. Bernstein, Herbert J. (Univ. of California, San Diego, La Jolla). J. Math. Phys. (N. Y.), 8: 406-8(Mar. 1967).

An elementary derivation of the system of phase factors defining the ray representations (those faithful to within a phase factor) of the Galilei group is presented. The proof employs the group elements themselves. In particular, the operation of conjugation (which corresponds to coordinate transformation) is used extensively to effect the desired result, i.e., in the notation of Levy-Leblond, $U(b', a', v', R')U(b,a,v,R) = \pm\exp[i(\frac{1}{2}m)(a' \cdot R'v - v' \cdot R'a + bv' \cdot R'v)] \times U(b' + b, a' + R'a + bv', v' + R'v, R'R)$. (auth)

27393 EMBEDDING OF A SIMPLE LIE GROUP INTO A SIMPLE LIE GROUP AND BRANCHING RULES. Navon, A.; Patera, J. (Univ., Montreal). J. Math. Phys. (N. Y.), 8: 489-93(Mar. 1967).

A criterion established by Dynkin is used to specify the embedding of a connected simple Lie group G′ into a connected simple Lie group G, and to derive a standard procedure for evaluating branching rules. It is shown that the weight systems of the irreducible parts contained in the representation of G′ induced by a given finite dimensional representation φ of G are obtained by projection of the weight system of φ. The projection mapping is determined directly from the specification of the embedding. The general procedure is supplemented with two constraint equations on the dimensions and indices of the irreducible representations. (auth)

27394 SYMMETRY WITHOUT SYMMETRY IN THE QUARK MODEL. Lipkin, H. J. (Weizmann Inst. of Science, Rehovoth, Israel). Nucl. Phys., B1: 597-612(1967).

A detailed analysis is given of quark-model predictions which are equivalent to those from higher symmetries even though no symmetry is explicitly assumed. These involve matrix elements between one-particle states classified in $U(6) \times U(6)$ representations of operators which have no specified symmetry properties but are single-quark or two-quark operators. From studying transformation properties of most general one- and two-quark operators results are obtained for strong, electromagnetic and weak decays, two-body scattering and reaction amplitudes, and mass splittings. General rules are given for obtaining symmetry results without detailed calculations, and the implications of symmetry breaking are discussed. (auth)

27395 SU_3 WIGNER COEFFICIENTS IN ANGULAR MOMENTUM SPACE. Iosifescu, M.; Stancu, F. (International Center for Theoretical Physics, Trieste, Italy). Nucl. Phys., B1: 471-82(1967).

SU_3 Wigner coefficients for the decoupling $(\lambda 1) = (\lambda'\mu') \times (\lambda''\mu'')$ and $(\lambda 0) = (\lambda'\mu') \times (\lambda''\mu'')$ with $(\lambda''\mu'') = (20)$ were obtained using basis functions of given angular momentum. (auth)

27396 CONCEPT OF ANTIPARTICLES IN PARTICLE MIXING. Patil, S. H.; Tomozawa, Y.; Yao, York-peng (Inst. for Advanced Study, Princeton, N. J.). Nuovo Cim. (10), 49A: 467-78(June 1, 1967).

Starting from the definition that the unstable physical particles are eigenstates of the mixing matrices, their relation to the physical antiparticles are considered. When there is CP invariance, the physical antiparticles are the CP-conjugate states of the physical particles. In particular, it is shown that K_1^0 and K_2^0 behave as particles at all times and to all orders of interactions, irrespective of the exponential decay law. When CP is violated, the question of whether the physical antiparticles are the CPT-conjugates of the physical particles is raised. In K^0-K^0 system, such a requirement leads to normality of the mixing matrix. However, in Λ-Σ^0 mixing, this requirement cannot be satisfied, so that in general the antiparticle states cannot be obtained from the particle states by CPT conjugation. (auth)

27397 RELATIVISTIC POSITION OPERATOR AT SUBATOMIC LEVEL. Castell, L. (Univ. of Kent, Eng. Canterbury and Trinity Coll., Dublin). Nuovo Cim. (10), 49A: 285-90(May 21, 1967).

A certain class of Lie algebras which contain the Lie algebra of the inhomogeneous Lorentz group and the relativistic position operators is derived, and it is shown how the Lie algebra of quantum mechanics is connected with the Lie algebra of the group $SO_{4,2}$. (auth)

27398 ON NONINVARIANCE GROUPS. Cicogna, G. (Scuola Normale Superiore, Pisa). Nuovo Cim. (10), 49A: 291-302 (May 21, 1967).

The problem of classifying elementary particles and of finding mass spectra by means of the noncompact group technique is reconsidered. It is concluded that this technique is not inconsistent, but it has so wide an applicability that it cannot give definite and significant information. It is shown in fact, by means of an extension of a method due to Weyl and Schwinger, that all possible systems of levels can be obtained, both nondegenerate and with any given degeneracy, and with any mass spacing as well. Moreover, on the footing of the noncompact group theory, the connection with the dynamical properties remains entirely arbitrary, or unknown. Some known "classical" systems are also reconsidered from this point of view. (auth)

27399 CLASS OF GENERALIZED GROUP CONTRACTIONS. Doebner, H. D.; Melsheimer, O. (Univ., Marburg, Ger.). Nuovo Cim. (10), 49A: 306-15(May 21, 1967).

In search for a pure group-theoretical description of an interacting system by a dynamical or noninvariance group it is required that the physically possible process of switching off the interaction should correspond to some limiting process connecting the dynamical group of the interacting system with the dynamical group of the corresponding free particle. Several possibilities for a mathematical formulation of this limiting process with different physical consequences are considered. Following an idea of Segal, it is supposed that the constants of structure of a Lie algebra L are functions of a set of real variables $\lambda = \{\lambda_i, i = 1, \ldots, p\}$ and a search is made for such L′ not isomorphic to L which can be obtained as a limiting algebra of L for $\lambda_i \rightarrow 0$, $i = 1, \ldots p$. (L.B.S.)

27400 PARTIAL SYMMETRY. Schwinger, Julian (Harvard Univ., Cambridge, Mass.). Phys. Rev. Lett., 18: 923-6(May 22, 1967).

Partial symmetry is proposed as the general basis for a phenomenological method that replaces current algebra. Its practical merit is displayed through a reinterpretation of combined internal and spin transformations. Among various results referring to coupling constants, magnetic moments, and electromagnetic decays, the following is noted: $-G_A/G_V = 2^{-1/2} \times 5/3 = 1.18$. (auth)

27401 FOUR-VALUED REPRESENTATIONS OF THE THREE-DIMENSIONAL ROTATION GROUP IN EUCLIDEAN SPACE. **Sannikov, S. S. (Ukrainian Physical-Technical Inst., Kharkov). Nucl. Phys., B1: 594-6(1967).**

A new representation of the rotation group R_3 corresponding to a weight $-1/4$ is constructed. It is an infinite-dimensional, irreducible, non-unitary, four-valued representation of the R_3 group (or two-valued representation of SU(2) group). The approach considered here is a basis for the construction of rotation group representations with complex spin and complex angular momentum. (auth)

27402 RELATIVISTIC MASS SPLITTING IN ASSOCIATIVE ALGEBRA. **Nakamura, Morio (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 37: 195-201(Jan. 1967).**

A method of combining the internal symmetry group and the Poincaré group is suggested to show an example of the relativistic mass splitting. The relation between the method and what was proved through the functional analysis by Jost and Segal is explained. (auth)

27403 THE REDUCTION OF DIRECT PRODUCTS IN SU(3). **Jasselette, P. (Univ., Liege). Nucl. Phys., B1: 529-34(1967).**

An explicit formula is derived by means of Kramer's symbolic method for the multiplicity of a given irreducible component in the Clebsch-Gordan series for the product of two irreducible representations of SU(3). (auth)

27404 APPLICATION OF KRAMERS' SYMBOLIC METHOD TO SU(3). **Jasselette, P. (Univ., Liege). Nucl. Phys., B1: 521-8(1967).**

Some preparations necessary for the application of the "spinor invariants method" to SU(3) are established. (auth)

Applications (Electromagnetic and Weak)

27405 T-NONCONSERVATION IN NUCLEAR MUON CAPTURE. **Oziewicz, Z. (Univ. of Wroclaw). Acta Phys. Pol., 31: 501-9(Mar. 1967).**

The correlations nonconserving T-parity in radiative muon capture in allowed and first forbidden transitions are calculated. The imaginary part of Gamov-Teller interaction is introduced. The results are compared with the β-decay. (auth)

27406 ELECTROMAGNETIC MASS DIFFERENCES AND COUPLING-CONSTANT RATIOS IN THE STRONG COUPLING GROUP SU(3) x SU(2) x T_{24}. **Biswas, S. N. (Univ. of Delhi); Patil, S. H.; Saxena, R. P. Ann. Phys. (N. Y.), 42: 494-507(May 1967).**

Assuming that the SU (3), SU (2) contents of the infinite unitary irreducible representation of SU (3) × SU (2) × T_{24} are $8^{1/2}$, $\overline{10}^{1/2}$, $10^{3/2}$, $27^{1/2}$, $27^{3/2}$, ... etc. as given by Goebel, relations between the various matrix elements of the generators of the group are obtained. The method employed is that due to Singh and Udgaonkar, based on the equivalence of the static strong coupling theory and the bootstrap conditions of the static pion nucleon scattering. As an application electromagnetic mass differences of octet baryons and decuplet resonances and their ratios were calculated. Various coupling and magnetic moments relations are predicted, in particular the decay width of $N^* \to N + \gamma$ is obtained in terms of proton magnetic moment. The results of these calculations are in reasonable agreement with experiment. (auth)

27407 UNITARY SYMMETRY AND THE HIGH-ENERGY PHOTONUCLEAR REACTIONS. **Lopes, J. Leite (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). An. Acad. Brasil. Cienc., 38: 11-25(Jan.-Mar. 1966).**

Relations are established among the amplitudes of several high-energy photonuclear reactions which lead to the production of mesons, baryons, resonances, and hypernuclei. The relations follow from the assumption that the electromagnetic interaction is invariant under the transformation of the U-spin subgroup of the SU_3 group. (L.B.S.)

27408 K^0 AND CP. **Marx, G. (Roland Eoetvoes Univ., Budapest). Fortschr. Phys., 14: 695-739(1966).**

The phenomenological theory of the neutral K-mesons (kaons) is summarized. The consequences of the C, CP, CPT symmetries are discussed in detail. Finally, the different suggestions are reviewed, concerning the explanation of the CP violating $K_L^0 \to \pi^+\pi^-$ decay. (auth)

27409 ELECTROMAGNETIC-MASS SUM RULES IN SU_3. **Moffat, J. W.; O'Donnell, P. J. (Univ. of Toronto). Nuovo Cim. (10), 49A: 99-107(May 1, 1967).**

The electromagnetic-mass sum rules for the spin-$1/2^+$ baryon octet are obtained using a method based on field theory and the algebra of currents in SU_3. Corrections to the physical-mass sum rules are calculated from the self-masses in quantum electrodynamics. In particular an estimate of the cross-term correction between the semi-strong and electromagnetic breaking of the Coleman-Glashow formula is evaluated. (auth)

27410 A UNIFIED MODEL OF T-VIOLATING ELECTROMAGNETIC AND WEAK INTERACTIONS. **Tsai, S. Y. (Japan Atomic Energy Research Inst., Tokyo. Nihon Univ., Tokyo). Progr. Theoret. Phys. (Kyoto), 37: 150-61(Jan. 1967).**

A phenomenological analysis is given of the electromagnetic and weak interactions of hadrons under the assumption that the relevant currents contain terms which transform as SU(3) decuplets as well as those as SU(3) octets. The rates and branching ratios for the various electromagnetic, weak and weak γ decays are estimated. The magnetic moment of Σ^+ is predicted to be 1.69 $e/2m_p$ and the branching ratio for the C-violating decay $\eta \to \pi^0e^+e^-$ is found to be $\sim 1 \times 10^{-3}$. It is emphasized that the possible C and T invariance violation can naturally be introduced by considering decuplet currents. (auth)

Applications (Strong)

27411 (UCRL-17388) SEARCH FOR HYPERONS AND BOSONS BELONGING TO HIGHER SYMMETRIES. **Goldhaber, Gerson** (California Univ., Berkeley. Lawrence Radiation Lab.). Feb. 1967. Contract W-7405-eng-48. 46p. (CONF-670108-3). Dep. CFSTI.

From 4th Conference on Symmetry, Coral Gables, Fla.

A discussion is given on the evidence found for the existence of higher symmetry groups. A review of the experimental situation is given. The topics covered are the possible existence of $K\pi\pi$ $I = 3/2$ and K^+K^+, $I = 1$, $S = 2$ states, the $p\pi^+\pi^+$ mass peak at 1560 MeV or a study in reflections, and the search for positive-strangeness hyperon resonances. (J.F.P.)

27412 (UCRL-17450) ON THE EQUAL MASS SPACING OF THE DECUPLET OF $J^P = 3/2^+$ BARYONS. **Slansky, Richard Cyril** (California Univ., Berkeley. Lawrence Radiation Lab.). Mar. 15, 1967. Contract W-7405-eng-48. 127p. Dep. CFSTI.

Thesis.

With the assumption that the unperturbed amplitude is known in the ND^{-1} representation, equations are derived for calculating the perturbed amplitude as a function of the variations of the left-hand singularities and the unitarity cuts. Exact formulas for mass and coupling-constant shifts of bound states of the unperturbed amplitude are given, and the equations are then iterated to yield a perturbation theory. The response of the decuplet masses to octet perturbations of the meson and baryon masses and couplings is studied in an ND^{-1} model of baryon-meson scattering, and it is found that the equal mass spacing of the decuplet is satisfied, even for large values of the symmetry breaking. The numerical inaccuracy of several forms of perturbation theory indicates that the physical baryon masses represent a large symmetry breaking in the calculation of the decuplet; so large that first- and second-order perturbation theories do not explain the equal mass spacing of the decuplet, although experiment and the exact solution to the model do give equal spacing. The rapid breakdown of the octet sum rules for the S-matrix elements also suggests that the SU(3) violations are large, and that the octet output is special to the masses. (auth)

27413 36-PLET-2^+-MESONS AND HIGH ENERGY SCATTERING. **Kitakado, Shinsaku (Nagoya Univ., Japan). Progr. Theoret. Phys. (Kyoto), 37: 636-8(Mar. 1967).**

The relation $(\bar{p} + p,p) = 3/2(\pi^+ + \pi^-,p) + 1/2(K^+ + K^-,p) - 1/2(K^+ + K^- + p)$ which follows from the quark model as well as from meson exchange is considered. Total cross section sums can be described satisfactorily neither by simple quark counting nor by meson exchange. This problem is analyzed from the viewpoint that 2^+ mesons, which dominate the total cross section sums, are expressed by 36-dimensional reducible representation of SU(3). (J.F.P.)

27414 SYMMETRY BREAKING QUASI-PARTICLE METHOD FOR BARYONS AND FOR QUARKS. I. BOUND STATE PROBLEM. **Wohlrab, K. S. (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Phys., B1: 551-71(1967).**

The quasi-particle method (essentially a non-perturbational approximation of quantum field theory) is applied to an SU_3 symmetric four-fermion interaction between octet-baryons N and antibaryons $\overline{N}$ (or between quarks and antiquarks). The method is developed in such a way, that the physical particles and resonances themselves appear as quasi-particles in a bound state approximation. The main weight is attached to the understanding of the principles of the method. The individual quasi-particle operators obtained are of the form $\Omega = uN + \nu\bar{N}^*$. Their eigenvalue spectrum is compared with the observed baryon resonances. Spontaneous dynamical breaking of SU_3 symmetry appears and leads primarily to a GMO formula for the gap constants, irrespective of the coupling strength. (Similar results are obtained for quarks.) The GMO formula for the baryon masses is obtained in the strong coupling limit. (Furthermore, mass formulae for quarks are derived.) Further it is shown in detail that the origin of the symmetry breaking is the fact that the quasi-particle method is an averaging approximation. Quasi-particles of higher order are considered in a preliminary way. Especially the meson spectra are treated in the lowest approximation. It is shown, that the first two of the three typical difficulties of the quasi-particle approximation [(i) inequivalent representations and degenerate vacua, (ii) parity mixed vacuum and (iii) spurious states ≡ Goldstone mesons] are avoided by the bound state approximation. The method is applicable to all compact symmetry groups. (auth)

27415 GROUP THEORY AND ELEMENTARY PARTICLES. Rowlatt, Penelope A. Mathematical Physics Series. New York, American Elsevier Publishing Co., Inc., 1966. 105p. $6.00.

The mathematics of the simple Lie algebras which underlie the symmetries of the strongly interacting particles is presented. A set of instructions for their use is provided. There are numerous examples of the application of theorems, and the theory is developed from first principles. The topics include basic concepts, general properties of simple Lie algebras, irreducible representations of simple Lie algebras, calculation of the matrix elements of representations from first principles, from basic representations by Kronecker multiplication, and by alternation. (J.F.P.)

Quantum Field Theories

27416 (IFA-FT-63) SELF COUPLED GENERALIZED VECTOR FIELDS OF YANG-MILLS TYPE. Lyakhovscki, V. D.; Tugulea, M. N. (Academia R. P. R.; Bucharest. Institutul de Fizica Atomica). 1966. 30p. Dep.

A study is made of the gage invariance problem of the considered interaction, the theory of T*-bracket in this case, some consequences of S-matrix invariance as the reducibility of the four-line interaction and the renormalizability. (auth)

27417 (JINR-E2-3266) PROBLEM OF CONSTRUCTION OF THE UNITARY RENORMALIZABLE FIELD THEORY WITHOUT ULTRAVIOLET DIVERGENCES. Volkov, M. K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1967. 14p. Dep.

A four-dimensional unitary relativistic model of quantum field theory without ultraviolet divergences with a nonunit S-matrix was constructed on the basis of the Lagrangian $L_{int}(x) = \Delta m$: $\bar{\Psi}(x)\, \tau_3\, e^{-12g\tau_1\phi(x)}\Psi(x)$. (auth)

27418 NONLOCAL QUANTUM THEORY OF THE SCALAR FIELD. Efimov, G. V. (Joint Inst. for Nuclear Research, Dubna, USSR). Commun. Math. Phys., 5: 42-56(1967).

A scheme of the construction of the S matrix according to the perturbation theory which is free of the ultraviolet divergences is suggested by the example of the one-component scalar quantized field. The causality is violated in small space-time region. The effects which are due to the causality violation at large distances are described by very high perturbation orders, and are therefore very small in the framework of the perturbation theory. (auth)

27419 LOCAL ONE-PARTICLE APPROXIMATIONS AND LOCALLY CONSERVED CURRENTS. Voelkel, A. H. (Univ., Hamburg). Commun. Math. Phys., 5: 57-72(1967).

Local one-particle approximations are constructed for matrix elements of two local field operators. If one of the fields is a locally conserved current the approximation is extended in such a way that both locality and current conservation are valid in the approximation. (auth)

27420 CONTINUOUS SYMMETRIES AND CONSERVED CURRENTS. Boyer, Timothy H. (Harvard Univ., Cambridge, Mass.). Ann. Phys. (N. Y.), 42: 445-66(May 1967).

The general relations between one-parameter continuous symmetries and conserved currents in local Lagrangian field theories is re-examined. Defining a symmetry transformation of a system of fields as a one-to-one mapping of the fields carrying solutions of the equations of motion into solutions, it is noted that not all symmetry transformations imply conserved currents, and conversely, not all conserved currents can be derived immediately from symmetries. However, the one-to-one correspondence between those local continuous symmetry transformations of the system which leave invariant the Euler–Lagrange equations from the original and transformed Lagrangians, and local conserved currents which can be written as linear functions of the Lagrangian derivatives is developed. It is shown that the theorem proved by Noether, which is customarily referred to in the construction of local conserved currents for some symmetry transformations, is in general related only tangentially to the problem in question. The analysis presented for the constructions of conserved currents seems of particular interest in the case that divergence terms enter the symmetry transformation; also it elucidates the independence of conserved currents from the ambiguity always present in Lagrangian formulations due to divergence terms in the original system Lagrangian. In the elementary cases of general interest in field theory, the procedures for the construction of conserved currents do not diverge significantly from the traditional ones, although even here the difference in attitude regarding the transformation is noted. The converse construction of symmetries from conserved currents was not considered fully in the literature. The general analysis is applied and extended for systems of fields allowing naive canonical quantization or quantization via the Schwinger action principle. In particular, the consistency of the interpretation of integrals of the currents as quantum generators of the original symmetry transformations is explored in full generality. (auth)

27421 ASYMPTOTIC QUANTUM FIELD THEORY. Chen, T. W. (Syracuse Univ., N. Y.). Ann. Phys. (N. Y.), 42: 476-93 (May 1967).

A quantum field theory with the following features is formulated: it is free of divergences and also free of the unphysical procedure of renormalization; the interaction can be specified in the dynamical equation; it gives consistent (renormalized) results for a renormalizable interaction; and it is also applicable to a nonrenormalizable interaction. The formulation assumes the Bogoliubov causality condition, the strong unitarity condition, the asymptotic condition, the completeness of the in-field (or out-field) and Lorentz covariance. The off- as well as on-mass-shell values play an important role in the formulation and they are treated carefully by employing the operator derivatives with respect to the in-field which satisfies the weak (or ordinary) free-field equation. A dynamical equation which determines all S-matrix elements is developed. The specification of interactions is made in this equation. It is then shown that finite perturbative solutions exist to any order and that the scattering matrix elements can be obtained by imposing suitable boundary conditions. No restrictions on the types of interactions appear in the formulation and, therefore, the same procedure can be carried out for renormalizable as well as for nonrenormalizable interactions. For renormalizable interactions, in particular, the dynamical equation reduces to the one previously proposed by Pugh. (auth)

27422 AXIOMS OF QUANTUM FIELD THEORY. Slavnov, D. A. (Moscow State Univ.). Zh. Eksp. Teor. Fiz., 52: 1224-32 (May 1967). (In Russian).

An attempt is made to modify the axiomatic method in quantum field theory in such a way that a nontrivial example of the theory may be formulated within the framework of the theory. The relevant axioms are formulated. A significant point is the application of nonequivalent representations of the canonical commutation relations. (auth)

27423 COALESCENCE OF PHOTONS IN A UNIFORM ELECTROMAGNETIC FIELD. Sannikov, S. S. (Physical-Technical Inst., Moscow). Zh. Eksp. Teor. Fiz., 52: 1303-4(May 1967). (In Russian).

Fusion of two photons into a single photon in the presence of an external homogeneous electromagnetic field is considered in the Schwinger formulation of quantum electrodynamics. An expression for the probability of the process is derived. (auth)

27424 SOME USEFUL RELATIONS CONNECTED WITH THE ASYMPTOTIC CONDITION IN QUANTUM FIELD THEORY. Garczynski, W.; Karwowski, W.; Sznajder, N. (Univ. of Wroclaw). Acta Phys. Pol., 31: 511-25(Mar. 1967).

The explicit and detailed presentation of asymptotic condition for a general field with vanishing matrix elements between the vacuum and one-particle states is given. Hepp's theory of asymptotic condition was used. Some concrete examples of such fields are considered. (auth)

27425 SINGULAR POTENTIALS AND THE Z = 0 CONDITION. Aly, H. H. (Univ. of Beirut, Lebanon); Mueller, H. J. W. J. Math. Phys. (N. Y.), 8: 367-72(Mar. 1967).

An interaction Lagrangian consisting of renormalizable and nonrenormalizable terms is considered. After a brief discussion of the vertex function and the boundary conditions determining the renormalization constant corresponding to a pseudoscalar bound state, an explicit expression for the nonrelativistic S-matrix for scattering by the potential $1/r^4$ is derived. These results are then used to evaluate Z. The explicit expressions obtained contain a strong cut-off dependence which cannot be factorized out. However, a specific value of the cut-off reduces the equation to a well-known eigenvalue problem, so that in this case a discrete spectrum of bound states may be obtained. (auth)

27426 THE CONDITION $Z_3 = 0$ AND EQUAL-TIME COMMUTATION RELATIONS. Lukierski, J. (Univ. of Wroclaw). Nuovo Cim. (10), 49A: 312-15(May 21, 1967).

The method of calculation of divergent mass integrals in Källén-Lehmann representation for the commutator function is presented. The behavior of the commutator function $G(x - x')$ is obtained for small values of $t - t'$. The result is obtained that the singularities in the canonical limit $t - t'$ and the zeros in the cut-off-dependent $Z_3(M^2)$ for $M^2 \rightarrow \infty$ are of the same order. (L.B.S.)

27427 PROPAGATOR IN THE NONRENORMALIZABLE THEORY. **Pevzner, M. Sh. (Dnepropetrovsk Mining Inst., USSR). Ukr. Fiz. Zh., 12: 564-7(Apr. 1967). (In Russian).**

The ladder approximation for the nonrenormalized propagator of the scalar particle interacting with the massive vector field is investigated. It is established that there exists a finite solution of the integral equation for the propagator, which behaves itself at $p^2 \rightarrow \infty$ as $(p^2)^{-1/4} \exp\{(g^2p^2)^{1/4} e^{\pm i(\pi+4)}\}$. The renormalization of the mass and propagator is finite in this case, but the propagator asymptotic behavior is in contradiction with the Källén-Lehman's spectral representation. (auth)

27428 GENERALIZATION OF THE STUECKELBERG FORMALISM TO THE MASSIVE YANG–MILLS FIELD. **Kunimasa, Tosaku; Goto, Tetsuo (Osaka Univ. Nihon Univ., Tokyo). Progr. Theoret. Phys. (Kyoto), 37: 452-64(Feb. 1967).**

Generalization of the Stueckelberg formalism to the massive Yang–Mills field (an example of non-Abelian gauge field) is performed in a way analogous to the Abelian gauge vector field. The compensating scalar fields in this case do not satisfy simple Klein–Gordon equations in contrast to the Abelian case where a scalar field with a certain mass value is introduced. It is also shown that the redundant fields can be eliminated by a suitable unitary transformation and therefore give no physical importance. (auth)

27429 COMPOSITE PARTICLES IN A TWO-DIMENSIONAL FIELD THEORY. **Haberler, P. L. F.; Saavedra, I. (International Atomic Energy Agency, Trieste, Italy). Nuovo Cim. (10), 49A: 194-6(May 1, 1967).**

The interaction of a vector field, with zero bare mass (electromagnetic field), with a fermion field with bare mass m_0 in the limit $m_0 \rightarrow 0$ in a two-dimensional model field theory is discussed. (J.F.P.)

27430 FEYNMAN–DYSON RULES FROM UNITARITY AND SELF CONSISTENCY. **Rosenberg, L. (New York Univ., New York). Nuovo Cim. (10), 49A: 439-58(June 1, 1967).**

As a partial test of a recently proposed theory, based on N-body linear integral equations and self-consistency ideas, the weak-coupling limit is examined and the Feynman–Dyson rules are derived. Since the integral equations are not solved exactly, but rather by iteration, the single-particle states must be separately inserted, and must show the correct (experimental) mass and pole residue. By requiring unitarity this insertion can be made in a fairly unambiguous way and leads to the Dyson–Schwinger equations. It is shown that, in perturbation theory at least, the requirements of unitarity and self-consistency lead to the normal spin-statistics connection. The concept of gauge invariance is arrived at without the introduction of vector potentials. (auth)

27431 PHILIPS' LORENTZ-COVARIANT LOCALIZED STATES AND THE EXTENDED-TYPE POSITION OPERATOR. **Gallardo, J. A.; Kalnay, A. J.; Stec, B. A.; Toledo, B. P. (Universidad Nacional de Cordoba, Argentina). Nuovo Cim. (10), 49A: 393-8(June 1, 1967).**

From a previous analysis of the problem of localization of elementary particles the conclusion is reached that the position should be redefined (extended-type position), and that the nonnormal operators are the adequate mathematical instruments to represent it. It is shown that Philips' definition of Lorentz-invariant localization leads to consequences compatible with the previous results. Moreover, it is shown that by means of the notion of binary position a correlation can be obtained between two localizations apparently antagonistic: Newton and Wigner's localization and Philips' localization. (auth)

27432 STUDY OF THE DEGENERATE ORBITAL OF THE COULOMB POTENTIAL IN GROUP THEORY. II. **Antoine, J. P. (Univ., Louvain, Belg.). Ann. Soc. Sci. Brux. Ser. 1, 81: 49-68(1967). (In French).**

The symmetry properties of the f-dimensional Coulomb problem are studied in the case of the continuous spectrum, extending a previous work devoted to the discrete spectrum only. Geometrical aspects are emphasized again, through the explicit use of the invariance group $SO_0(f,1)$, and not only of its Lie algebra. As a by-product, the known mass-shell discontinuity of the Coulomb wave function is re-obtained in the momentum representation, as well as that of the Coulomb T-matrix. Finally, the zero energy case is shown to admit the Euclidean group $E(f)$ as an invariance group. (auth)

27433 A QUANTIZATION OF A SPINOR FIELD IN THE GENERALIZED HILBERT SPACE. **Tokuoka, Zensuke (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 37: 581-602(Mar. 1967).**

A quantization of a spinor field is analyzed on the basis of the general Lagrangian, which gives the Dirac equation, in the generalized Hilbert space. The Lagrangian is classified into three; the first one is essentially equivalent to the Dirac one except for sign and is rather docile, the second is a new type and the field considered should be quantized essentially in an indefinite metric space, and the third is the Majorana one. It is also shown that the first field is a mixture of two definite Majorana fields and the second is a mixture of a definite and an indefinite Majorana fields. The expansion of a field in momentum space to get a particle interpretation is rather obvious for the first field but not for the second. (auth)

27434 ON THE LONGITUDINAL AND SCALAR PHOTONS IN LORENTZ GAUGE AND LORENTZ CONDITION. **Goto, Tetsuo (Nihon Univ., Tokyo). Progr. Theoret. Phys. (Kyoto), 37: 571-80(Mar. 1967).**

Quantization of the radiation field in Lorentz gauge is re-examined and it is shown that without using indefinite metric a consistent formulation is possible. Though it is not necessary to modify the usual supplementary condition, one should not regard a vector potential $A_\mu(x)$ as a Hermitian operator. It is suggested that the results of physical interests, however, are the same as those obtained from the ordinary formulation. (auth)

27435 RELATIVISTIC INVARIANCE IN QUANTUM FIELD THEORY AND COMMUTATION RELATIONS FOR DENSITIES. **Shiozaki, Takanori (Nagoya Univ., Japan). Progr. Theoret. Phys. (Kyoto), 37: 183-94(Jan. 1967).**

The conditions for the relativistic invariance in quantum field theory are investigated on a fairly general assumption. Relations are obtained in the form of the equal-time commutator of energy and momentum densities. These basic relations must be satisfied by any fields having intrinsic spin and local interactions, and they generalize Schwinger's results. (auth)

27436 MASS SPECTRA IN γ_5- AND SU_3-INVARIANT NONLINEAR FIELD THEORY. Kurdgelaidze, D. F. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz., No. 3, 53-63(1966). (In Russian).

Determination of mass spectra in γ_5- and SU-invariant nonlinear spinor field theory without second quantization is discussed. A detailed study was made of mass spectrum for γ_{5-}-, SU_2-, and SU_3-invariant theory. (tr-auth)

27437 FORMULATION OF THE MATHEMATICAL THEORY FOR NATURAL LINE WIDTH. **Ingolfsson, Ketill (Univ., Zurich). Helv. Phys. Acta, 40: 237-63(1967). (In German).**

The quantum field theory, defined in an infinite space and developed on the ideas of V. FOCK and K. FRIEDRICHS, gives the foundation for a general method of solution for quantum field problems. The Laplace transform of the time dependent state vector in the Schrödinger picture is proved to be a solution of the Laplace transform of the wave equation. The conditions for the identity of the inverse transform of that solution with the original state vector and also some other rules for the Laplace transformed space will be derived. The method of solution consists then in the following procedure: The Laplace transform of the wave equation is solved; The solution is retransformed. The well known physical problem of the emission of light from an excited electron in a bound state and the corresponding calculation of the line width is to be treated by means of this method. The following discussion shows, that the conditions for the solution are fulfilled, the ordinary Hamiltonians in a Hilbert space, corresponding to lowest order perturbation theory are used. At the end, the calculation of this solution is briefly pointed out. A connection to the method of HEITLER and Ma is easily found. The use of a Hilbert space, corresponding to general perturbation theory, is sketched. (auth)

27438 THE MOMENTUM SPACE ANALYTICAL FUNCTION CORRESPONDING TO ONE OF THE TERMS IN THE BERGMAN–

WEIL REPRESENTATION FORMULA FOR THE VERTEX FUNCTION. Andersson, Bo (Univ. of Lund, Sweden). Nucl. Phys., B1: 581-93(1967).

The momentum space analytic function $I(Z_1, Z_2, Z_3; \rho)$ corresponding to the configuration space function,

$$F(z_1, z_2, z_3, \rho) = \frac{\sum_{i=1}^{3} [\log(-z_i) - \log(\rho - z_i)]}{\rho - \rho(z_1 + z_2 + z_3) + z_1z_2 + z_1z_3 + z_2z_3}$$

is computed and the following formula is proved: $I(Z;\rho) = -2(2\pi)^5 \int d\sigma\, \tilde{\Delta}(\sigma,\rho)\, F(Z;\sigma)$. The function $F(z;\rho)$ is singular on one of the three-point function singularity surfaces, the F-surface of Källén and Wightman, and occurs in the Bergman–Weil representation formula for the general vertex function. (auth)

Scattering Theory

27439 (JINR–P2-3250) INTEGRAL'NYE PREDSTAVLENIYA RELYATIVISTSKIKH AMPLITUD I ASIMPTOTICHESKIE TEOREMY. (Integral Representations for Relativistic Amplitudes and Asymptotic Theorems). Kuznetsov, G. I.; Smorodinskii, Ya. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1967. 10p. (In Russian). Dep.

Asymptotic integral representations for the relativistic amplitudes of particle and antiparticle scattering are obtained from the existence of the amplitude expansion in irreducible infinite dimensional unitary representations of the Lorentz group. On the basis of the integral asymptotic representations the equality of the amplitudes of high-energy particle and antiparticle scattering at zero angle is proved. (auth)

27440 MODEL OF DOUBLE CHARGE EXCHANGE. Yanev, R. K. (Leningrad State Univ.). Zh. Eksp. Teor. Fiz., 52: 1221-3(May 1967). (In Russian).

A model of double nonresonance charge exchange at intermediate and low velocities is considered in which the probability of the process is represented as the square of the probability for single charge exchange. The cross sections obtained for the model are in good agreement with the experimental data. (auth)

27441 TWO-BODY SCATTERING WITH WAVE PACKETS. Hammer, C. L.; Weber, T. A. (Ames Lab., Iowa). Contract W-7405-eng-42. J. Math. Phys. (N. Y.), 8: 494-506(Mar. 1967). (IS–1361).

Two-body scattering is analyzed using a time-dependent formalism and wave packets of arbitrary shape as the initial wavefunctions. In particular, the case of single-channel resonant scattering is discussed in some detail. In addition to the usual amplitudes resulting from the potential term and the resonant term, a third amplitude is found which interferes with the other two. Another interesting result is that in this formalism the final state is not necessarily represented by spherical outgoing waves, but can be interpreted instead as two separate outgoing wave packets whose shape is different from the initial packets. The Wigner time delay is obtained as a natural consequence of the analysis, and the resonant cross sections are expressed as density matrices constructed from the wave packets. (auth)

27442 RELATION BETWEEN THE RELATIVISTIC AND NONRELATIVISTIC S-MATRICES. Halpern, Francis R. (Univ. of California, San Diego, La Jolla). J. Math. Phys. (N. Y.), 8: 648-50(Mar. 1967).

It is shown that, given any Lorentz invariant S-matrix, it is possible to calculate from it, by purely algebraic operations, a Galilean invariant S-matrix, and vice versa. (auth)

27443 NON-USUAL TOPOLOGIES ON SPACE–TIME AND HIGH-ENERGY SCATTERING. Atkinson, D.; Halpern, M. B. (Univ. of California, Berkeley). J. Math. Phys. (N. Y.), 8: 372-87(Mar. 1967).

Motivated by recently observed deviations from quantum electrodynamical theory, the possibility that notions of space–time may need revision at small distances is studied. In this work, attention is called to certain techniques which are available for studying different space–time structures within the framework of topology. The main effort is in the consideration of an unusual topology on space–time in which is embedded an elementary length. By working separately in each n-particle subspace, the embedding is done in an inhomogeneous Lorentz invariant way, and any lattice structure in space–time is avoided. Particles in this topology are in general extended structures, and the surprising feature is found that, at high energies, the topology enhances backward and large-angle scattering. From these preliminary investigations, one is not as yet able to make more than qualitative comparison with experiment. Along the way, the opportunity was found to remark on ways of embedding an intrinsic breakdown of certain invariances (e.g., parity) in the topology of space–time. (auth)

27444 STRONG COUPLING LIMIT IN POTENTIAL THEORY. I. Frank, William M. (Bar-Ilan Univ., Ramat Gan, Israel). J. Math. Phys. (N. Y.), 8: 466-72(Mar. 1967).

Analytic properties of the Jost function in g, the coupling constant, are studied for potentials which are $L^{1/2}$, i.e., $\int_0^\infty dr\, |V(r)|^{1/2} < \infty$, and have a negative power or exponential tail for large distances. For the bound state and scattering problems, it is found that the Jost function has exponential order ½ for large g, which implies that the scattering phase shift and the number of bound states in an attractive potential grow like $|g|^{1/2}$ for large g. The latter result is the best possible and is a considerable improvement over earlier estimates. (auth)

27445 PADE APPROXIMANT AND PARTIAL-WAVE INTEGRAL EQUATION. Masson, D. (Univ. of Toronto). J. Math. Phys. (N. Y.), 8: 512-14(Mar. 1967).

The Padé approximant is applied to the partial-wave integral equation and is shown to yield approximate solutions which satisfy exact two-body unitarity and which converge to the N/D solution. (auth)

27446 EXISTENCE OF N AND D MATRICES. Hartle, James B.; Taylor, John R. (Princeton Univ., N. J.). Contract AF49(638)-1545. J. Math. Phys. (N. Y.), 8: 651-6(Mar. 1967).

The existence of N and D matrices with the property that the partial-wave T matrix has the form $T = ND^{-1}$ is established. The case of a finite number of two-body channels is considered, and prove that, if T is analytic with right- and left-hand cuts and is suitably bounded, then N and D can be constructed with all the usual properties—namely, N and D have the left- and right-hand cuts, respectively, N is finite at the bound-state poles, and D tends to one as the energy goes to infinity. (auth)

27447 LEE MODEL WITH COULOMB EXCHANGE. Hannover, Hilmar (Univ., Muenster, Ger.). Z. Phys., 201: 490-506(1967). (In German).

The Hamiltonian of the Lee model in the sector (1,0) with an additional NΘ-interaction is diagonalized by means of Green's operator $(E-H)^{-1}$. In addition to a continuous spectrum of scattering states one gets a discrete spectrum consisting of a ground-state level determined essentially by Lee's interaction H_1, and excited states generated by the additional interaction H_2. (auth)

27448 INTEGRAL EQUATIONS FOR THE GENERALIZED JOST FUNCTION. Ciulli, S.; Ghika, Gr.; Stihi, M.; Visinescu, M. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys., 12: 195-222(1967).

The one-channel scattering problem is solved in the Jost function formalism. The discontinuity of the S-matrix along the unphysical cut being given, a Riemann problem is stated in the momentum k-plane which leads to a singular integral equation for the generalized Jost function. A unified treatment for both cases, when the phase shift at infinity is or is not an integral multiple of π is given. In both cases, the singular integral equation is reduced to a Fredholm-type one, with a Hilbert-Schmidt kernel. (auth)

27449 ON THE POSSIBILITY IN PRINCIPLE OF EXPERIMENTAL TEST OF THE EXISTENCE OF A STATIONARY SINGULARITY OF THE SCATTERING AMPLITUDE WITH A VANISHING FIELD COUPLING CONSTANT IN RENORMALIZED THEORIES. Lomsadze, Yu. M.; Tokar, S. S. (Uzhgorod State Univ., USSR). Ukr. Fiz. Zh., 12: 554-8(Apr. 1967). (In Russian).

It is pointed out that in distinction to electrodynamic and renormalized theories the question of the existence of renormalized meson theories of a scattering amplitude singularity at the point $g^2 = 0$, where g is the physical coupling constant of the fields, should be regarded as unsolved. Two radical methods are proposed for the experimental solution of this problem: the Mittag-Loeffler method and a method based on an analytical continuation in a complex n-plane coefficient function $U_n(s,t)$—the coefficient of the nth member of the series of the perturbation method for the amplitude. The first method may be applied to the effective calculation of the scattering amplitude of strongly interacting particles with arbitrary energies; the second—with asymptotic energies. (auth)

27450 STUDY OF CERTAIN KERNELS INTERVENING IN SCATTERING THEORY. Combes, Jean-Michel (IHES, Bures-sur-Yvette, Essonne, France). Compt. Rend., Ser. B, 264: 195-8(Jan. 16, 1967). (In French).

Given some two-body operators V^{ij} and W^{jk} ($i \neq k$), the nature of the products $V^{ij}W^{jk}$ on the representation space of the relative motion of the three particles i, j, and k is studied. (tr-auth)

27451 SUM RULES AND SCHWINGER TERMS IN EQUAL-TIME COMMUTATORS. Lu, E. Y. C. (Cambridge Univ., Eng.). Nuovo Cim. (10), 49A: 136-51(May 1, 1967).

A method, generalizing the recipe of Bjorken for exploring consequences of the assumed equal-time commutation relations is presented and sum rules are then derived from the chiral $U_6 \times U_6$ algebra. The method can be modified to cope with the more singular terms involving derivatives of delta-functions and then a recipe for detecting and isolating the contribution of such terms is discussed. Information on the Schwinger-term structure of the complete chiral $U_6 \times U_6$ algebra is obtained. Under suitable assumptions the connection of subtraction constants with Schwinger terms is also discussed. Further, an example where an assumed subtracted dispersion relation implies Schwinger terms in the equal-time commutator is considered. (auth)

27452 EXISTENCE OF SOLUTIONS OF PARTIAL-WAVE DISPERSION RELATIONS AND SINGULAR N/D EQUATIONS. Contogouris, A. P.; Martin, A. (CERN, Geneva). Nuovo Cim. (10), 49A: 61-72(May 1, 1967).

It is shown that, for left-hand discontinuities which asymptotically exceed certain limits imposed by unitarity, the partial-wave dispersion relation admits no ghost-free solutions. However, for discontinuities which on the left tend to a limit λ, $0 < \lambda < 1$, the singular integral equation that arises by application of the usual N/D approach is shown to lead to a one-parameter manifold of ghost-free solutions; in particular, a specific solution which is analytic at $\lambda = 0$ belongs to this manifold. The variation of the zeros of the D function (for varying λ) is shown explicitly in a simple example. (auth)

27453 SYMMETRIES OF SCATTERING INCLUDING MASS SPLITTING. Stern, J. (Faculty of Technical and Nuclear Physics, Prague). Nuovo Cim. (10), 49A: 33-50(May 1, 1967).

A new approach to the problem of symmetries of scattering is developed, which allows an unambiguous inclusion of the effect of mass differences. The proposed method goes beyond the usual group-theoretical approach because the assumption that two-particle states transform like members of the direct product of the corresponding one-particle representation spaces must be abandoned. The necessity of such a generalization is demonstrated. A general but simple way is found by which relations among scattering amplitudes can be derived, starting from certain plausible assumptions. There is no need to assume any concrete algebra (or group) describing the symmetry of scattering. The whole approach is demonstrated in the quark-quark and quark-antiquark scattering. (auth)

27454 COMPOSITENESS CRITERIA FOR PARTICLES WITH IDENTICAL QUANTUM NUMBERS. Kang, K. (Brown Univ., Providence). Nuovo Cim. (10), 49A: 415-34(June 1, 1967). (NYO-2262TA-135).

The compositeness criteria for channels containing two and three particles were examined by making use of a previously proposed approach. The previous formalism is extended to take into account the possible zeros of the propagator function. Under the reasonable assumptions on both high- and low-energy behaviors of the scattering amplitude so as to guarantee the minimal number of arbitrary parameters, it is found that the matrix of the wave-function renormalization constant becomes singular, i.e., det $Z = 0$ as soon as at least one of the particles in the channel becomes a bound state defined as in the S-matrix theory, thus confirming our previous results. The positive real constant obtained from the Herglotz property of the single-particle reducible part of the scattering amplitude is incorporated to analyze systematically the various situations. In particular, the importance of including a CDD term due to a zero of the propagator in the scattering amplitude is noticed when a bound state is to be generated in the channel to an elementary particle. (auth)

27455 ON THE VALIDITY OF THE REGGE FORMULA IN THE UNEQUAL-MASS CASE. Nakanishi, Noboru (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 37: 618-31(Mar. 1967).

The validity of the Regge formula in the relativistic scattering theory is examined on the basis of the Green's function formalism. It is shown that in the unequal-mass case some Regge trajectories on the mass shell become ghosts in a certain real interval of the invariant energy squared. This result clarifies how the kinematical unphysical singularities appearing in the Khuri formula are canceled by the daughter trajectories proposed by Freedman and Wang. The order of the daughter trajectory is identified with $n-l-1$, where n and l are the principal and the azimuthal (angular momentum) quantum number, respectively. The Khuri asymptotic formula in the unequal-mass case is discussed in a ladder model of massless-scalar-particle exchange, and is explicitly demonstrated to be free from the kinematical unphysical singularities. (auth)

27456 UNITARITY CONDITION AND HIGH ENERGY SCATTERING. Bando, Masako (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 37: 544-57(Mar. 1967).

The effects of unitarization procedure using the K matrix are investigated in the case of 2 channel model. Two kinds of effects are discussed, one is the self-damping effect and the other is the absorption effect, when the exchanged particle has no spin. Also the self-damping effect is investigated in the high energy limit in the case of the exchanged particle with spin, and the amplitude obtained by this procedure is compared with that obtained by assuming the Regge hypothesis. (auth)

27457 OFF THE REAL AXIS SINGULARITIES IN PARTIAL-WAVE AMPLITUDES. Gupta, Yogendra Mohan; Watal, Chitra; Agarwal, Bipin Kumar (Univ. of Allahabad, India). Progr. Theoret. Phys. (Kyoto), 37: 209-10(Jan. 1967).

A general prescription which transforms off the real axis singularities, in the energy plane of the partial wave amplitude, on to the real axis even in the case when all the masses are different is provided for the general scattering process with two ingoing and two outgoing particles. (J.F.P.)

27458 DELAY TIME OPERATOR FOR SIMPLE SCATTERING SYSTEMS. Jauch, J. M.; Marchand, J.-P. (Univ. of Geneva). Helv. Phys. Acta, 40: 217-29(1967).

A discussion is given for the concept of delay time associated with the collision process and its relation to the phase shift in a single channel scattering process. This concept is reformulated in the context of the scattering theory of Jauch, which avoids the use of eigenfunction expansions. This allows a definition of the delay operator for more general scattering systems (for which the eigenfunction expansion need not be valid) to be given, and a simultaneous determination of the condition of validity for this relation between the delay operator and the scattering operator. (J.F.P.)

27459 RELATIVISTIC MODEL OF A DAUGHTER REGGE TRAJECTORY. Swift, Arthur R. (Univ. of Wisconsin, Madison). Contract AT(11-1)-881. Phys. Rev. Lett., 18: 813-16 (May 8, 1967). (COO-881-102).

A model based on ladder diagrams in a $\lambda\varphi^3$ theory is used to study the first daughter trajectory in the scattering of unequal-mass particles. It is found that the daughter pole moves towards the physical region less rapidly than the leading pole, and develops a smaller imaginary part at the two-particle threshold. The motion of the daughter pole is determined primarily by three-particle scattering processes. As a consequence, a model which fails to treat three-particle scattering accurately cannot give a detailed picture of the motion. (auth)

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Refer also to abstracts 26932 and 27353.

27460 (BNL-11336) EFFECT OF INSULATION BETWEEN VACUUM CHAMBER SECTIONS ON RESISTIVE INSTABILITIES. Courant, E. D. (Brookhaven National Lab., Upton, N. Y.). Apr. 19, 1967. Contract AT(30-2)-Gen-16. 4p. Dep. CFSTI.

It was shown that the transverse resistive instability is the same when the vacuum chamber is sectioned off with capacitive flanges between sections as when the vacuum chamber is electrically continuous. The growth rate term V in the longitudinal instability is also unaffected; however, there is an effect on the threshold for this instability. (auth)

27461 (BNL-11346) SEPARATED FUNCTION MAGNET LATTICE FOR A VERY HIGH ENERGY SYNCHROTRON. Danby, G. T.; Allinger, J. E.; Jackson, J. W. (Brookhaven National Lab., Upton, N. Y.). [1967]. 27p. (CONF-670705-2). Dep. CFSTI.

From 2nd International Conference on Magnet Technology, Oxford, England.

The magnetic characteristics of a separated function magnet lattice are discussed and the problems raised by this design are investigated. (B.G.D.)

27462 (CALT-68-128) TAGGED PHOTON BEAM SPECTRUM. Wolverton, Frank B. (California Inst. of Tech., Pasadena. Synchrotron Lab.). Apr. 28, 1967. Contract AT(11-1)-68. 19p. (CTSL-33). Dep. CFSTI.

The spectrum of photons, positrons, and electrons in a tagged photon beam was calculated. Since the energies involved were large compared to the electron mass, it was neglected in computing energy balances in the reactions considered. (B.G.D.)

27463 (CEAL-1027(Rev.A)) SPECTRAL AND ANGULAR DISTRIBUTIONS OF SYNCHROTRON RADIATION. Mack, R. A.

(Cambridge Electron Accelerator, Mass.). Feb. 3, 1966. Contract AT(30-1)-2076. 20p. Dep. CFSTI.

Spectral and angular distributions of synchrotron radiation are described, tabulated, and plotted in a more general form than has previously been reported. (auth)

27464 (CONF-660939-11) STATUS OF THE MURA 200-MeV ELECTRON-POSITRON STORAGE RING. Rowe, E. M.; Hicks, J. W.; Johnson, R. G.; Lee, G. M.; Meier, H. K.; O'Meara, J. E. (Midwestern Universities Research Association, Stoughton, Wis.). Sept. 1966. 9p. DTIE.

From International Symposium on Electron and Positron Storage Rings, Saclay, France.

A brief description of the MURA 200-MeV electron-positron storage ring is presented. The major components are then described in more detail. (B.G.D.)

27465 (N-67-11359) RADIOACTIVE NUCLEI PRODUCTION FROM RELATIVELY ABUNDANT NATURAL ELEMENTS. Janda, Robert J. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). July 1966. 14p. (NASA-TM-X-55577; X-716-66-248). CFSTI $3.00 cy, $0.65 mn.

Tables are given as a guideline in evaluating potential radioactive nuclei production that could affect experiments or personnel in an accelerator laboratory. The elements included in the table were selected based on the following criteria: theoretical reaction threshold energies less than 17.0 MeV, half-life time greater than 0.2 sec, and natural element abundance greater than 1%. The table is intended to serve accelerator personnel by estimating half-life for materials placed within the accelerator beam, taking into account beam energy and particle type in determining whether the reaction goes to completion. It is pointed out that the table indicates only whether a potential reaction exists, and not necessarily that the reaction constitutes a radiological hazard. An example is given of using the table in evaluating the relative hazard of a proton beam on an aluminum target. (STAR)

27466 (NP-16619) REENCLENCHEMENT AUTOMATIQUE DU POMPAGE ET SECURITE NEUTRONS DE L'ACCELERATEUR GNP 1. (Automatic Reengagement of Pumping and Neutron Safety of the GNP-1 Accelerator). Note Technique Acc. 65-18. Giloppe, D.; Pontonnier, M. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Nov. 1965. 15p. (In French). Dep.

Two automatic devices added to the GNP-1 accelerator in order to start the pump in operation again after a voltage loss and to avoid a sudden neutron burst are described. The circuit for the partial automation of the pumping system is given in detail. (J.S.R.)

27467 (NP-16698) REPORT ON THE WORK OF THE INSTITUTE OF NUCLEAR SCIENCES. Progress Report No. 8, May 1966-December 1966. (Institute of Nuclear Sciences, Lower Hutt (New Zealand)). 77p. (INS-229). Dep.

Research projects in nuclear physics, radiation applications, isotope geochemistry (stable isotopes), radioactive dating and fallout, isotope applications, and instrumentation are discussed. (B.G.D.)

27468 (RHEL/R-119) AN EXPERIMENTAL ANALYSIS OF 90^0 UNIFORM FIELD BEAM BENDING MAGNETS FOR USE WITH ELECTROSTATIC GENERATORS. Morris, W. R. (Rutherford High Energy Lab., Chilton (England)). Sept. 1966. 40p. Dep. CFSTI. HMSO 11s. 0d.

An experimental analysis of two 90° uniform field beam bending magnets using field measuring techniques and defined beams of alpha particles is described. The role of these magnets now in use with the Oxford Nuclear Structure Project is discussed and the theory of focusing is outlined. A brief description of the design of each magnet is included. The test arrangements and analytical methods employed in conducting the magnetic field surveys and alpha particle ray tracing are detailed. The results obtained are listed and compared with the theoretical values and the reasons for any differences in the results discussed. (auth)

27469 (UCRL-17195) REMOTE MAINTENANCE TECHNIQUES PROPOSED FOR THE 200-GeV ACCELERATOR. Krevitt, Roland (California Univ., Berkeley. Lawrence Radiation Lab.). Feb. 16, 1967. Contract W-7405-eng-48. 11p. (CONF-670307-44). Dep. CFSTI.

From National Particle Accelerator Conference, Washington, D. C.

Remote maintenance is one of the prime considerations in determining the size of the main-ring enclosure for the 200-GeV accelerator. The maximum residual radiation level 7 h after beam turn-off is expected to be $\sim$50 mR/h in the so-called quiet areas of the main ring and approximately 200 R/h at the most intense point in the enclosure. A maximum permissible radiation dose per man of one-half the permissible dose allowed by AEC regulations was assumed. Therefore, an unshielded man can work for a few hours per week in the quiet areas, but only a few seconds per week in the red radiation areas. For these red radial areas, a self-propelled manned shielded vehicle on which are mounted two master-slave manipulators to be used as a backup for extension tools penetrating the vehicle walls was proposed. (auth)

27470 (UCRL-17247) CAPABILITY VS COST FOR SERVICING AND HANDLING SYSTEM CHOICES IN 200-GeV ACCELERATOR DESIGN STUDY. Salsig, W. W. (California Univ., Berkeley. Lawrence Radiation Lab.). Feb. 15, 1967. Contract W-7405-eng-48. 10p. (CONF-670307-39). Dep. CFSTI.

From National Particle Accelerator Conference, Washington, D. C.

Unprecedented size, residual radiation, and the need for quite reliable operation of the 200-GeV accelerator present new challenges in servicing and maintenance. Yet costs must not be disproportionately large. An example servicing solution is developed, and variations are investigated for costs. It is shown that large-percentage cost changes are not to be expected, but that small changes can represent millions of dollars. Therefore extraordinary care should be exercised in refining appropriate solutions. The era of thorough preconstruction mock-up work has arrived in the accelerator business! (auth)

27471 (UCRL-17254) CERAMIC VACUUM CHAMBER FOR A FAST-CYCLING PROTON SYNCHROTRON. Clee, Peter T.; Hernandez, H. Paul (California Univ., Berkeley. Lawrence Radiation Lab.). Feb. 1, 1967. Contract W-7405-eng-48. 14p. (CONF-670307-38). Dep. CFSTI.

From National Particle Accelerator Conference, Washington, D. C.

Alumina ceramic vacuum chambers are proposed in the area of the magnets for the 8-GeV injector synchrotron of the 200-GeV accelerator. The chambers cannot be made in one piece, and the only acceptable joint involves metal, which has a perturbing effect on the magnetic field. For this reason it was proposed that the longest possible ceramic be used to keep the joints to a minimum, but long ceramics require wider tolerances, and this becomes costly in magnet gap. Sample ceramics produced by industry were examined, and from the results the overall cost of ceramics and magnet gap were related to ceramic length. Installing and locating the chambers in the magnet gap is difficult due to the restrictions of shape and size of the gap. (auth)

27472 (UCRL-17264) SELECTION OF A LAMINATION SHAPE FOR A FAST-CYCLING ALTERNATING-GRADIENT MAGNET CORE. Hernandez, H. Paul (California Univ., Berkeley. Lawrence Radiation Lab.). Feb. 18, 1967. Contract W-7405-eng-48. 11p. (CONF-670307-40). Dep. CFSTI.

From National Particle Accelerator Conference, Washington, D. C.

The selection of each dimension of a C-shaped, 18-cps alternating-gradient magnet core lamination is based upon reliability, design, and cost considerations. Cost differentials of magnet-gap height, pole-tip width, return-path widths, etc., are given. Stranded-conductor coils were found significantly more economical to operate than solid conductor coils because of the reduction in eddy-current power. Three cost minimums are discussed: the width of the flux return path, the coil conductor cross section, and the coil aspect ratio. The width of the flux-return path is emphasized and is selected slightly above the minimum cost where the magnetomotive force changes slowly. (auth)

27473 (UCRL-17268) A PRESTRESSED-CORE HOLLOW-STRAP-COIL TEST MAGNET FOR THE OMNITRON. Scalise, D. T.; Hoyer, E. H. (California Univ., Berkeley. Lawrence Radiation Lab.). Feb. 23, 1967. Contract W-7405-eng-48. 11p. (CONF-670307-45). Dep. CFSTI.

From National Particle Accelerator Conference, Washington, D. C.

Design, fabrication, and preliminary testing of a test prototype gradient magnet for the Omnitron incorporating several novel design features is reported. The laminated magnet core achieves structural integrity with prestressed tension rods which hold the 0.014-in.-thick M-19 steel laminations with an average inter-lamination pressure of 200 psi. Some advantages of such a system are: elimination of strong backs for support of individual laminations, a higher steel packing factor than for glued laminations, and easy disassembly of the magnet to make changes during test and development. Simplicity in coil design is achieved using a continuous $^9/_{32}$- by 3-in. hollow-strap aluminum conductor wound in a single layer. The high section modulus of the strap eliminates the need for coil clamps at the ends of the magnet. Furthermore, this coil design avoids multiple cooling connections between pancakes and saddle-shaped coil ends, because notches can be machined into the coils after they are wound. (auth)

27474 (UCRL-17274) A SMALL ^{3}He CYCLOTRON. Main, R. M.; Curtis, M. R.; Grazier, R.; Kennedy, P. B.; Smith, B. H.; Spence, D. A. (California Univ., Berkeley. Lawrence Radiation Lab.). Mar. 1967. Contract W-7405-eng-48. 12p. (CONF-670307-37). Dep. CFSTI.

From National Particle Accelerator Conference, Washington, D. C.

A 27-inch AVF cyclotron of fourfold symmetry designed specifically for use in helium-3 activation analysis is now in operation at the Lawrence Radiation Laboratory in Berkeley. The fixed energy and modest beam quality requirements have resulted in an instrument of minimum size, weight, power consumption, and fabrication costs. New techniques were developed to construct edge-cooled tape-wound magnet coils which are housed inside the vacuum chamber. Other unusual design features include: unit construction dee liners hydraulically pressed to the pole tip contours; two 55° dees-in-valleys operating in push-pull; a removable top yoke assembly which allows complete access to the pole area; a narrow gap with an average spacing of 1.5 inches making possible maximum utilization of the pole diameter for stable orbits. In conjunction with the tape coils, the use of this small gap also results in a magnet of very high efficiency. The cyclotron operates with an average field of 16.6 kG and a grounded-grid triode provides 40 kV dee-to-ground (150 keV/turn). Power is supplied by 220 V, 3-phase service. The magnet requires 17 kW, the rf system uses 17 kW, and the remaining instruments, pumps, and controls use an additional 6 kW. The complete system, including vacuum pumps and power supplies, weighs 10.7 tons and occupies a floor space of 37 × 64 inches. (auth)

27475 (UCRL-17276) EXPANSION OF THE BEVATRON EXTERNAL PROTON BEAM EXPERIMENTAL FACILITIES. Lou, Kenow H. (California Univ., Berkeley. Lawrence Radiation Lab.). Feb. 17, 1967. Contract W-7405-eng-48. 9p. (CONF-670307-42). Dep. CFSTI.

From National Particle Accelerator Conference, Washington, D. C.

The External Proton Beam Channel has seen intensive utilization since its installation at the Bevatron. A program now in progress will further enhance its versatility by increasing target areas, beam intensities, experimental floor area, shielding and utilities. The physical facilities, among which is a truly unique overhead crane design is described. The proton beam operation and characteristics are discussed in the Bevatron Experimenters Handbook. (auth)

27476 (UCRL-17446) POLE-ZERO ANALYSIS OF DISTRIBUTED RADIO-FREQUENCY ACCELERATION SYSTEMS. Katz, J. E.; Kerns, Q. A. (California Univ., Berkeley. Lawrence Radiation Lab.). Mar. 14, 1967. Contract W-7405-eng-48. 5p. (CONF-670307-41). Dep. CFSTI.

From National Particle Accelerator Conference, Washington, D. C.

It is shown that the frequency-dependent input impedance of a lossless distributed network may be represented by the frequencies of the input impedance poles and zeros. Then, given the network reactance at a single frequency other than that of a pole or zero, one may apply Foster's reactance theorem to determine the input impedance at any frequency. Using the frequency-dependent impedance representation, one may calculate the response of the system to any periodic driving function. (auth)

27477 (UCRL-17451) RF SYSTEM CONSIDERATIONS IN INTERLACED-BEAM INJECTOR SYNCHROTRONS. Tool, G. S.; Kerns, Q. A. (California Univ., Berkeley. Lawrence Radiation Lab.). Mar. 16, 1967. Contract W-7405-eng-48. 9p. (CONF-670307-43). Dep. CFSTI.

From National Particle Accelerator Conference, Washington, D. C.

The general characteristics of the rf system high-power components and suitable accelerating structures were studied for several variations of the interlaced multi-ring synchrotron. This type of machine was considered as a possible component of the injection system for the 200-BeV accelerator. (auth)

27478 (LA-tr-65-32) PULSED ION SOURCE WITH A CATHODE NEEDLE. Lapitskii, Yu. Ya.; Khoroshkov, V. S. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). Translated by Helen J. Dahlby (Los Alamos Scientific Lab., N. Mex.), from Report No. 380, 1965. 10p. Dep. CFSTI. JCL $1.10 fs, $0.80 mf.

A pulsed source with a cold cathode with a fixed discharge region is described. The ion emission current is 0.3 A. With a pulse length of 50 μsec and a pulse frequency of 0.2 cycles per second, the life of the source is several thousand hours. Gas consumption is 25 cm^3/hour. The power dissipated in the source is 35 Watts. (auth)

27479 (ORNL-tr-1533) EVALUATION OF THE SHIELD FOR A 5-GeV GAMMA-BEAM WITH NUCLEAR EMULSIONS. Beerwald, G.; Passow, C. (Technische Hochschule, Hanover (West Germany)). Translated for Oak Ridge National Lab., Tenn., from report ABS-THH-1013. 13p. Dep. CFSTI. JCL $1.60 fs, $0.80 mf.

The gamma beam available for radiation shielding measurements was utilized to expose nuclear emulsions behind the shield. First data with nuclear emulsions in a background produced by a gamma beam are available. In addition, it was possible to determine the fluxes of thermal and fast neutrons, shower particles in the cascade, and the star-producing component at discrete points in the shield. (auth)

27480 (SLAC-Trans-27) THE EFFECT OF EXTERNAL CIRCUITS ON COHERENT INSTABILITY. Chirikov, B. V. Translated by T. Watt (Stanford Linear Accelerator Center, Calif.), from a Russian Preprint, 1965. 13p. Dep. CFSTI. JCL $1.60 fs, $0.80 mf.

The effect of external circuits connecting the chamber walls of an accelerator on the coherent instability of the accelerated beam is discussed. (B.G.D.)

27481 CHARACTERISTICS OF A LOW ENERGY DUOPLASMATRON NEGATIVE ION SOURCE. Aberth, William; Peterson, James R. (Stanford Research Inst., Menlo Park, Calif.). Rev. Sci. Instrum., 38: 745-8(June 1967).

A duoplasmatron was constructed specifically to produce negative ion beams of less than 5 keV energy. Design parameters are given for construction and operation of the source. Ion beam energy analyses indicate an energy full width at half maximum of less than 10 eV, and when the ion beam energy is extrapolated to zero, a full width at half maximum of 3 eV is observed. Ion beams of H^-, O^-, OH^-, F^-, CN^-, and NO_2^- were produced at 2 keV with beam intensities between 3×10^{-7} and 10×10^{-7} A, measured behind a 0.63 cm diam aperture 140 cm downstream from the source. (auth)

27482 IONIC BOMBARDMENT DEVICE OF THE "EOLION" TYPE. Warnecke, R. J.; Masic, R.; Vincent, G. (CSF-Compagnie Generale de Telegraphie Sans Fil, Orsay, France). Vide, 22: 47-56(Jan.-Feb. 1967). (In French).

An ionic bombardment device using a duoplasmatron type source is described. Its characteristics are the following: usable mass range is $1.0 < m < 40$; ion energy in kV is $5 < E < 30$; current transported by the beam in mA is $5 < I < 10$; and beam diameter is 10 cm. The anode of the ion source is provided with an expansion chamber whose geometry was studied in order to obtain a radial density distribution as uniform as possible. (tr-auth)

27483 DETERMINATION OF THE ENERGY OF ELECTRON BEAMS IN LINEAR ACCELERATORS BY MEANS OF ANALOG COMPUTOR ELEMENTS. Armenskii, E. V.; Pyatnov, E. G.; Chalyi, V. D. Izmeritel. Tekh., 2: 46-8(Feb. 1967). (In Russian).

A method for the mathematical description of the energy as a function of the input parameters in the form of second degree polynomials was proposed. The possibility of the use of analog computers for the determination of the energy in the accelerator without discontinuation of the radiation studies was proved with errors not exceeding ±3%. (tr-auth)

27484 METHODS FOR MEASURING THE MAGNETIC INDUCTION OF STRONG CONSTANT MAGNETIC FIELDS. Yagola, G. K.; Agbalyan, Yu. G. Izmeritel. Tekh., 2: 6-13(Feb. 1967). (In Russian).

Methods for measuring magnetic induction generally make it possible to carry out comparative measurements with limited precision. An increase in precision and expansion of the measurement range require extended study and improvement of measurement devices. Devices constructed on galvano-magnetic and magneto-plasma phenomena require calibration with respect to standard facilities in all the measurement intervals. Principally the calibration of the measurement generator and the magneto-optical meter by the calculation method is permissible. The result of practical possibilities in the precision of preparation of converters and indicator instruments show that their calibration by known fields is expedient. The most precise and reliable absolute measurement of magnetic induction are devices based on nuclear magnetic resonance. However their utility is limited by the range of the homogeneous magnetic field. In the presence of homogeneous strong magnetic field sources nuclear meters can be used as standard devices for the calibration and control of other types of magnetic induction meters. Mistakes in the measurement of nuclear meters were investigated in fields up to 2.5 mg. The use of the method of nuclear magnetic resonance for the precise measurement above 2.5 mg with utilization of the resonance of different atomic nuclei requires a close investigation of all possible factors affecting the precision of the measurement. For guarantee of the unity and precision of the measurements in new ranges of strong magnetic fields the development of precision meters of magnetic induction and highly stable sources of homogeneous fields are required. (tr-auth)

27485 IMPROVEMENT OF THE YIELD OF A HIGH FREQUENCY ION SOURCE AND ITS PULSATION. **Hansart, A.; Landercy, M. A.; Noblet, A.; Sylin, G. (Univ. Libre, Brussels). Nucl. Instrum. Methods, 50: 245-50(1967). (In French).**

In order to increase the current extracted from a high frequency ion source, an experimental set-up has been constructed. The measurement of the source characteristics is first described. The transmission of the high-frequency energy to the source has been improved by the use of transmission lines, in order to match the impedances between the hf generator and the ion source. In that way, the maximum possible current was extracted, and the target current was increased from 0.6 mA to 5 mA. In the second part, a completely transistorized source pulsation unit was studied, which permits power gain and makes the driving of the source pulsation much easier. The target current pulses may vary from 10 ms to 5 μs width, with rise time of about 1 μs, while completely conserving the maximum amplitude obtained in the continuous mode. (auth)

27486 RUNGE-LENZ VECTOR AND THE COULOMB GREEN'S FUNCTION. **Hostler, Levere (Univ. of Pittsburgh. Yale Univ., New Haven). J. Math. Phys. (N. Y.), 8: 642-6(Mar. 1967).**

The fact that the Runge-Lenz vector is an extra constant of the motion for a charged particle moving in a Coulomb potential is found to account for the especially simple structure of the nonrelativistic coordinate space Coulomb Green's function. Also, the study of the consequences of this extra constant of the motion leads to a separation of variables in the differential equation for the coordinate space Coulomb Green's function, and hence to a new derivation of the closed-form expression for this Green's function which avoids the use of infinite series and the detailed properties of special functions. (auth)

27487 MULTIPLE FREQUENCY ACCELERATION OF $^4He^+$ IONS IN THE U-120 CYCLOTRON. **Indreas, Gr.; Tauth, Th. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys., 12: 159-64(1967).**

The acceleration of $^4He^+$ ions was performed on the third harmonic of the fundamental frequency in a U-120 cyclotron. The mean intensity of the deflected beam was of about 50 μA. Without any modification of the existent shimming for protons one can cover the energy range from 1.6 to 2.2 MeV. (auth)

27488 HIGH PRECISION FARADAY CUP AND QUANTAMETER FOR SLAC. **Yount, D. (Stanford Univ., Calif.). Nucl. Instrum. Methods, 52: 1-14(June 1967). (SLAC-PUB-264).**

Specifications and test data are given for a 20-GeV Faraday cup and quantameter as well as for several hydrogen ion chambers used as reference monitors. The Faraday cup has been designed to have unity efficiency for electrons or positrons to an accuracy of better than ±0.1% at energies up to 20 GeV. Tests carried out at energies up to 15 GeV indicate an absolute efficiency of 100.0 ± 0.2%. The quantameter was designed to have a gain linear in electron, positron, or photon energy to ±0.1%. In tests with the Faraday cup using the electron beams at Stanford and at SLAC, the quantameter has been calibrated to ±0.3% and its linearity established to an accuracy of ±0.2% at energies up to 15 GeV. (auth)

27489 DEVELOPMENT OF A FFAG-ELECTRON SYNCHROTRON OF THE RADIAL-SECTOR TYPE (FINAL ENERGY ~150 MeV). VII. DESIGN AND BROAD-BAND MATCHING OF THE ACCELERATING ELECTRODES (CALCULATIONS AND MODEL MEASUREMENTS). **Mohl, D. (Freie Univ., Berlin). Nucl. Instrum. Methods, 52: 109-18(June 1967). (In German).**

The design and broad band matching of the acceleration cavities was examined by means of calculations and model tests. Measurements were carried out at a power level of about 5 W on a system which consisted of models of the cavities, the matching network and the final amplifier. The cavities consist of C-shaped, quarter-wave "drift plates," each of which covers a portion of the radial aperture inside the vacuum-chamber (multi-stage rf-system). The characteristics of the cavities and the rf-fields arising at the edges (r = const) of the Cees were measured. Two matching schemes are compared. The first is of low Q type, with flat transmission characteristics similar to the low Q double tuned bandfilter-scheme used in existing accelerators, but with a lower power consumption. The second scheme, being of high Q three circuit type—despite of the need for an effective amplitude control— is found to be more suitable for large bandwidth. (auth)

27490 ENERGY REPRODUCIBILITY IN BEAM ANALYZING MAGNETS. **Snelgrove, J. L.; Kashy, E. (Michigan State Univ., East Lansing). Nucl. Instrum. Methods, 52: 153-4(June 1967).**

Measurements of magnetic field reproducibility made with one of the Michigan State University cyclotron beam analyzing magnets indicate that an energy setting can be reproduced to better than 1 part in 1500. (auth)

27491 EMITTANCE MEASUREMENTS WITH A DUOPLASMATRON ION SOURCE. **Wroe, H. (Brookhaven National Lab., Upton, N. Y.). Nucl. Instrum. Methods, 52: 67-76(June 1967).**

Measurements of the emittance of the output beam of a duoplasmatron ion source are described. The slotted plate and copy paper used and the effects of space charge on the measurements is discussed. It is shown that space charge effects are significant in the beam emerging from the source and that, for meaningful measurements, narrow slits, 0.001" wide, should be used. A source geometry is described which produces a 60 mA beam free from the effects of aberrations, at 40 kV. Using a plate with 0.05 mm dia. pin holes, the invariant emittance of this beam is 6×10^{-3} cm · mrad and this value is shown to be consistent with a simple theoretical calculation. When the beam is accelerated to 750 kV in the preinjector of the Brookhaven AGS the invariant emittance increases by more than an order of magnitude. (auth)

27492 MAGNETIC ANALYZER SYSTEM FOR THE INS TOKYO SYNCHROCYCLOTRON. **Yagi, K.; Ogawa, H.; Ishizaki, Y.; Ishimatsu, T.; Kokame, J.; Matsuda, K. (Tokyo Univ.). Nucl. Instrum. Methods, 52: 29-47(June 1967).**

A magnetic beam analyzer system and a product-particle spectrometer of a broad-range type for a 55-MeV proton beam from the INS Tokyo synchrocyclotron are described. The beam analyzer system consists of a beam analyzer magnet and a beam cleaning magnet. A well focused and cleaned beam is obtained at the target position. The beam intensity is about 45 nA when the energy spread of the analyzed beam is 0.1%. The product-particle spectrometer is composed of a uniform-field sectorial magnet and a preceding quadrupole-magnet doublet. The spectrometer can analyze and detect simultaneously particles over an energy range from E_{max} to 0.67 E_{max}. A multicounter system of an array of 200 proportional counters followed by a large plastic scintillation counter system is arranged at the focal plane of the spectrometer. The 200 proportional counters serve as position detectors, and compose counter telescopes with the scintillation counters. A momentum spectrum of analyzed particles is stored and displayed by the use of the core memory of an 1024 channel pulse height analyzer. An over-all energy resolution 0.14% and a solid angle 2×10^{-3}sr are obtained. The design, construction, testing, and operation of the magnetic analyzer system are described. Results of various calibrations, i.e., plots of dispersion, resolution, solid angle, energy measurements, etc., are given. (auth)

27493 STABILIZATION OF BETATRON OSCILLATIONS. **Kulikov, O. F.; Loskutov, Yu. M.; Yarov, A. S. (Moscow State Univ.). Nuovo Cim. (10), 49A: 224-32(May 21, 1967).**

The stabilization of electron oscillation amplitudes at constant energy in synchrotrons was investigated experimentally and theoretically. It has been shown that one can obtain satisfactory agreement between the experimental results and theory only taking into account the fact that the electron energy levels in the oscillator potential-well are discrete. (auth)

27494 THE 45 MeV LINEAR ELECTRON ACCELERATOR AT SACLAY. **Roland, S.; Bergere, R.; Joly, R.; Vendryes, G. Bull. Inform. Sci. Tech., (Paris), No. 113, 35-46(Mar. 1967). (In French).**

A description of the experiments, performed since April 1962 are presented. Physical phenomena concerning electrons-waves interactions as well as improvements of the performances are discussed. The characteristics of our machine are then compared with those of other more recent linacs exploited along the same lines. (auth)

27495 USE OF THE LINEAR ACCELERATOR AS PULSED NEUTRONS SOURCE FOR PHYSICAL RESEARCH. **Michaudon, A.; Joly, R.; Vendryes, G. Bull. Inform. Sci. Tech. (Paris), No. 113, 47-60(Mar. 1967). (In French).**

The objectives and the techniques involved are summarized. Finally, comments on experiments carried out since 1962 and the information on nuclear-level characteristics which was deduced are presented. (auth)

27496 THE ADONE COMPLEX IN THE FRASCATI NATIONAL LABORATORY OF THE CNEN. **Cerchia, R. (CNEN, Frascati, Italy). Riv. Ing. Nucl., 4: 1055-74(May-June 1966). (In Italian).**

The safety criterion for the Adone complex are first briefly outlined. Then a rather complete description is given of the building itself, including the linac and the storage ring building. (J.S.R.)

27497 EXPERIMENTAL STUDY OF THE TRANSMISSION OF RADIATION THROUGH THE PASSAGES IN THE PROTECTION SYSTEM OF HIGH-ENERGY ACCELERATORS. **Rindi, Alessandro (CERN, Geneva); Tardy-Joubert, Philippe. Ind. At., 11: Nos. 3-4, 53-60(1967). (In French).**

In order to arrive at a picture which is as simple as possible of the approaches to the high energy accelerators of the approaches to the high energy accelerators of the future, an experimental study of a propagation of neutrons and of the attenuation of the dose absorbed was undertaken with the CERN 600 MeV synchro-cyclotron and the 28 GeV proton synchrotron. The conclusions treat the comparison of attenuation in straight-line and curved tunnels, and the effectiveness of a trap installed in this latter. Development of the results also leads to conclusions as to the effect of losses at the entrance of the tunnels and as to the variation of the doses in terms of the energy of the accelerated protons. (auth)

27498 METHOD AND APPARATUS FOR ACCELERATING IONS OF ANY MASS. **Smith, Bob H.; Main, Robert M.; Ghiorso, Albert (to U. S. Atomic Energy Commission). U. S. Patent 3,328,708. June 27, 1967.**

A synchrotron is described in which ions of any mass can be accelerated. The ions can be accelerated in two or more synchrotron acceleration stages, the ions being transferred to a storage ring between acceleration stages while the synchrotron magnetic field intensity is being reduced to a minimum value. Additional electrons are stripped from the ions prior to each additional stage of acceleration to obtain a more advantageous charge-to-mass ratio necessary for further acceleration of the ion in the synchrotron. The accelerating components of the synchrotron provide for using harmonics of a basic radio-frequency range to accommodate for the differing charge-to-mass ratios encountered. (AEC)

27499 INDUCTIVE WALL STABILIZATION OF INTENSE CIRCULATING PARTICLE BEAMS. **Briggs, Richard J. (to U. S. Atomic Energy Commission). U. S. Patent 3,324,325. June 6, 1967.**

Dielectric coatings are described for use in the interior walls of beam guides such as cyclotrons, storage rings, etc. Charged particle beams traveling in such guides are inherently unstable due to the negative mass instability which causes an undesirable bunching of the particles. The dielectric coating interacts with the beam to limit the growth of such particle bunches. The thickness of the coating is precisely correlated with the beam energy to provide a structure best suited for beam stabilization. (AEC)

27500 IMPROVEMENTS IN AND RELATING TO CYCLOTRONS. **(to Philips' Gloeilampfabrieken). British Patent 1,067,291. May 3, 1967. Priority date Apr. 18, 1963, Netherlands.**

An isochronous cyclotron is described which can operate at two different values of magnetic flux and comprises an electromagnet having pole pieces with segments of large height alternating with an equal number of segments of small height. (B.G.D.)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 27008, 27226, 27255, 27495, 27516, 27579, and 27663.

27501 (AAEC/E-163) GUNYA: A SYSTEM OF CODES FOR THE PREPARATION GYMEA CROSS SECTION DATA LIBRARIES. Cook, J. L. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Sept. 1966. 16p. Dep.

A system of computer programs called GUNYA is described which prepares multigroup cross section information suitable for input to the burnup code GYMEA. (auth)

27502 (AAEC/TM-343) DATA PREPARATION AND BIBLIOGRAPHY FOR THE GYMEA LIBRARY NDXC. Cook, J. L. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Sept. 1966. 12p. Dep.

A summary of data preparation methods and codes is given together with a compilation of references which were the sources for data contained in the GYMEA cross section library NDXC. (auth)

27503 (AE-274) SCATTERING OF NEUTRONS BY AN ANHARMONIC CRYSTAL. Hoegberg, T.; Bohlin, L.; Ebbsjoe, I. (Aktiebolaget Atomenergi, Stockholm (Sweden)). Apr. 1967. 38p. Dep.

Numerical calculations were performed for the anharmonic effects in neutron scattering. The phonon frequency widths and shifts were calculated as a function of neutron frequency at different wave numbers and temperatures for a potential with central symmetry and for fcc lattice. (auth)

27504 (LA-DC-8478) BIORTHOGONAL ANGULAR POLYNOMIAL EXPANSIONS OF THE TWO DIMENSIONAL TRANSPORT EQUATION. Lathrop, K. D.; DeMuth, N. S. (Los Alamos Scientific Lab., N. Mex.). [1966]. Contract W-7405-eng-36. 4p. (CONF-670602-2). Dep. CFSTI.

From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif.

In forming approximations to the Boltzmann transport equation, a common approach involves the expansion of the angular dependence of the directional flux in spherical harmonic functions. A method is described in which the directional flux is expanded in either of two systems of polynomials in two variables. (D.C.W.)

27505 (UCRL-50229) A CALCULATION OF THE AGE AND FAST EFFECT FOR MONOENERGETIC NEUTRONS IN Be AND BeO. Perkins, S. T. (California Univ., Livermore. Lawrence Radiation Lab.). Mar. 1967. Contract W-7405-eng-48. 9p. Dep. CFSTI.

The age and fast effect have been calculated for monoenergetic sources in Be and BeO by a multigroup solution of the moments equations. Recent nuclear data were utilized, including the breakup of the ^{9}Be (n,2n) reaction, as well as a detailed description of the differential cross sections. The energy-angle correlation was preserved for all reactions. The calculated ages to indium resonance (1.4 eV) for 14.1-MeV source neutrons were 128 and 134 cm^2 in Be ($\rho = 1.85$ g/cc) and BeO ($\rho = 2.80$ g/cc), respectively. Corresponding values for the fast effect were 2.59 in Be and 1.48 in BeO. (auth)

27506 (WAPD-TM-601) MEASURED NATURAL NEUTRON SOURCE IN ^{233}UO$_2$-ZrO$_2$ AND ^{233}UO$_2$-ThO$_2$. Emert, C. J.; Milani, S. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Apr. 1967. Contract AT(11-1)-Gen-14. 41p. Dep. CFSTI.

Reactor cores containing ^{233}U and oxygen intimately bound in a fuel matrix are capable of generating an appreciable source of neutrons from the ^{18}O(α,n)^{21}Ne reaction. Most of the alpha particles for this reaction originate from the radioactive decay of ^{233}U. Because of the relatively short half-life of ^{233}U, the neutron source is large compared to that from fuels containing ^{235}U and ^{238}U. To demonstrate the effectiveness of this reaction in producing neutrons and to give some degree of confidence in the calculation of such a source, two experiments were undertaken. The first experiment involved a direct measurement of the neutron emission from 26 w/o ^{233}U O$_2$-ZrO$_2$ seed rods and from 1 w/o ^{233}U O$_2$-ThO$_2$ blanket rods when immersed in a manganese sulfate bath. The second experiment measured the natural source from a small seed and blanket reactor using an experimental technique developed by Milani and Doub. A calculation was also undertaken using the cross-section data of Bonner to evaluate the natural source. The natural source from ^{233}U fuel rods as measured with the manganese sulfate bath, inferred from the seed-blanket core, and as calculated are in nominal agreement. (auth)

27507 NEUTRON WAVE PROPAGATION EXPERIMENTS IN GRAPHITE. Utsuro, Masahiko; Shibata, Toshikazu (Kyoto Univ.). J. Nucl. Sci. Technol. (Tokyo), 4: 205-8(Apr. 1967).

The effects of the Bragg cut-off on neutron penetration in graphite were analyzed using two-group theory based on neutron wave propagation experiments in graphite. Some typical experimental results for graphite systems are given; the experimental data support the effectiveness of simple two-group theory for analysis of Bragg cut-off effects. (D.C.W.)

27508 MEASUREMENT OF NEUTRON SLOWING DOWN TIME IN GRAPHITE. Kaneko, Yoshihiko; Kurokawa, Ryosuke; Akino, Fujiyoshi; Sumita, Kenji (Japan Atomic Energy Research Inst., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 4: 177-84(Apr. 1967).

A series of pulsed neutron experiments was performed to investigate the chemical binding effect on the neutron slowing-down time. Bursts of D-T neutrons of 1 μsec-width were generated in a hexagonal prism of reactor grade graphite with a density of 1.54. The slowing-down neutrons were detected by bare as well as energy-selective filter-covered BF$_3$ counters and were analyzed with a 256-channel time analyzer. Slowing-down times in graphite were determined by interpreting the increment of the difference of events between the two counters to be due to the contribution made by the fraction of the slowing-down neutrons at the time of measurement that was below the cut-off energy of the filter. The results of measurements showed good agreement with calculation based on the crystal model. (auth)

27509 EIGENVALUES OF THE NEUTRON TRANSPORT OPERATOR FOR A HOMOGENEOUS FINITE MODERATOR. Ukai, Seiji (Kyoto Univ.). J. Math. Anal. Appl., 18: 297-314 (May 1967).

A homogeneous moderator of a finite convex body with the assumption that the scattering of neutrons is isotropic is considered for the eigenvalues of the neutron transport operator. Attention is given to the discrete spectrum of the corresponding operator which lies in the half-plane $\mathrm{Re}\lambda > \lambda^*$ (λ^* being defined as $v\Sigma_t(v) \simeq \lambda^* + bv^2$, for a gas and a solid, and $v\Sigma_t(v) \simeq \lambda^* + bv$, for a liquid). (J.F.P.)

27510 EIGENVALUES AND EIGENFUNCTIONS OF THE NEUTRON TRANSPORT EQUATION FOR A SLAB. Kiesewetter, H. (Univ., Rostock, Ger.). Kernenergie, 10: 8-14(Jan. 1967). (In German).

A method which can be considered as a generalization of the Wiener-Hopf method is proposed, according to which all the eigenvalues and eigenfunctions of the neutron transport equation for a slab may be constructed. The system of eigenfunctions is analogous to the well-known trigonometrical system. The new functions are different from the trigonometric functions in their behavior near the surface. Especially, the eigenfunctions of the neutron transport equation for a full sphere can be derived from the odd eigenfunctions for the slab. Essential simplifications occur as compared to the results of the Case method. (auth)

27511 MOTION OF NEUTRON IN MAGNETIC FIELD OF SPECIAL CONFIGURATION. Bagrov, V. G.; Stepanov, V. E. Ivz. Vyssh. Ucheb. Zaved., Fiz., No. 1, 142-6(1967). (In Russian).

The presence of bound neutron states in a magnetic field with a special configuration is discussed. It was previously shown that neutron motion in a constant magnetic field is described by wave functions corresponding to the free neutron motion with alterations for spin coefficients. However, there are also magnetic field configurations with bound-state neutrons and, consequently, with discrete energy levels. In such cases strong interactions are absent, and the discrete energy levels appearing at the expense of purely electromagnetic interactions are theoretically investigated. (R.V.J.)

27512 DENSITY MEASUREMENT OF POLYETHYLENE AND POLYSTYRENE AT 77 AND 4.2°K. Rauch, H.; Tenor, P. (Oesterreichische Hochschule, Vienna). Atomkernenergie, 12: 163-4(May-June 1967). (In German).

The density of polyethylene and polystyrene was measured at 77 and 4.2°K by means of an electron transmission method. The product of density times thickness ($\rho \cdot d$) was determined, and consequently the number of nuclei per cm^3 at the different temperatures could be determined. This is of special interest for evaluation of neutron cross sections as a function of temperature. (auth)

27513 COLD NEUTRON CROSS SECTIONS OF POLYETHYLENE AND POLYSTYRENE AT LOW TEMPERATURES.

Lasinger, F.; Rauch, H. (Oesterreichische Hochschule, Vienna). Atomkernenergie, 12: 159-62(May-June 1967). (In German).

The total cross section for thermal-, Be-filtered- and Bi-filtered neutrons of polyethylene and polystyrene at room temperature, 80 and 4.2°K was measured. The measured values are compared with theoretical ones, which are based on the Goldman model. The cross sections decrease for every measured spectra down to 80°K. Between 80 and 4.2°K an increase of the cross section for Be-filtered neutrons was observed. (auth)

27514 INTERACTION OF ADJACENT THERMAL NEUTRON DETECTORS IN WATER. **Izumi, Shigeru; Watarumi, Chikae (Tokyo Inst. of Tech.). J. Nucl. Sci. Technol. (Tokyo), 4: 115-20(Mar. 1967).**

Thermal neutron flux perturbation due to two or three adjacent detectors in water has been experimentally investigated. The detectors employed were gold foils and pins. The results were compared with theoretical values calculated on the basis of Dalton's theory. The comparison gives fairly good agreement. (auth)

Nuclear Properties and Reactions, $A \leq 5$

Refer also to abstracts 27540, 27642, 27650, and 27576–27579.

27515 (INP-534/PL) DIFFRACTION OF HIGH ENERGY NUCLEONS ON NUCLEI AND THE REAL PART OF THE NUCLEON-NUCLEON SCATTERING AMPLITUDE. **Czyz, W.; Lesniak, L. (Institute of Nuclear Physics, Krakow (Poland)). Feb. 1967. 14p. (CONF-670207-4). Dep.**

From 2nd International Conference on High Energy Physics and Nuclear Structure, Rehovoth, Israel.

A method of analyzing high-energy nucleon-nucleus scattering in terms of nucleon-nucleon elastic scattering amplitude is presented and the results compared with the recent experimental data. (auth)

27516 (LA-DC-8781) THE ${}^1H(n,n)$ CROSS SECTION AS A NUCLEAR STANDARD. **Hopkins, John C. (Los Alamos Scientific Lab., N. Mex.). [1967]. Contract W-7405-eng-36. 31p. (CONF-670517-1). Dep. CFSTI.**

From IAEA Meeting on Nuclear Standards Needed for Neutron Cross Section Measurements, Brussels, Belgium.

The suitability of the ${}^1H(n,n)$ cross section as a primary standard for neutron-flux measurements in the energy range above 100 keV is examined. The use of the ${}^1H(n,n)$ cross section in relative measurements, in proton recoil devices, and in counter calibration applications is discussed. The total cross section is well known while the differential elastic cross section is very poorly known. A prescription is given for the calculation of the differential cross section at all energies. The conclusion is that the ${}^1H(n,n)$ cross section would be a suitable primary standard for energies above 100 keV. A recommendation is made for action in three areas: the techniques for flux measurement should be improved; an accurate differential cross section measurement should be made; and a serious theoretical study should be made to calculate the differential and total cross sections from known phase shifts. (auth)

27517 FAST FORWARD NEUTRON PRODUCTION IN THE d(p,n)2p REACTION FOR 95.7 AND 143.9 MeV PROTONS. Langsford, A. (Atomic Energy Research Establishment, Harwell, Eng.); Bowen, P. H.; Cox, G. C.; Dolley, P. E.; Riddle, R. A. J.; Saltmarsh, M. J. M. Nucl. Phys., A99: 246-68(1967). (AERE-R-5380).

The cross section for the production of fast, forward-going neutrons in the d(p,n)2p reaction was measured at mean proton energies of 94.7 and 143.9 MeV and was compared with the predictions of the impulse approximation. This calculation took into account the final-state interaction of the two, slow, residual protons. The agreement in cross-section values is within the limit of experimental accuracy which is about 10%. The shape of the neutron spectrum was measured with an energy resolution of 1.90 ± 0.06 MeV at 95.7 MeV. Within the limits imposed by this energy resolution, there is good agreement between the calculated neutron spectra and that observed. (auth)

27518 VECTOR POLARIZATION IN d–α SCATTERING. Trier, A.; Haeberli, W. (Univ. of Wisconsin, Madison). Contract AT(11-1)-Gen-7. Phys. Rev. Lett., 18: 915-17(May 22, 1967). (COO-7-0414).

A beam of polarized deuterons was scattered from a helium target. The results show that d–α scattering is a useful analyzer for deuteron vector polarization for most deuteron energies between 2.5 and 10 MeV. It is also observed that the d–α break-up reaction is strongly dependent on deuteron spin. (auth)

27519 MEASUREMENT OF THE DIFFERENTIAL CROSS SECTION IN PROTON–PROTON SCATTERING AT 49.41 MeV. **Batty, C. J. (Rutherford High Energy Lab, Eng.); Griffith, T. C.; Imrie, D. C.; Lush, G. J.; Robbins, L. A. Nucl. Phys., A98: 489-502(1967).**

The differential cross section for proton–proton elastic scattering at 49.41 MeV was measured at 30 angles between 13 and 90° (cms) with an absolute precision of 0.5 to 0.7% over most of the angular range. The 90° cms cross section is compared with other data near 50 MeV. (auth)

27520 NUMERICAL CALCULATIONS FOR THE GROUND STATE OF A SIMPLE TRITON MODEL. Van Wageningen, R.; Kok, L. P. (State Univ., Groningen, Netherlands). Nucl. Phys., A98: 365-83(1967).

Numerical calculations were performed for the ground state of a triton model, in which the three "nucleons" are identical and spinless. The interaction is assumed to be a sum of two-particle, local, central potentials, for which various forms were taken. Only completely symmetric trial functions of the product type f(x)f(y)f(z) were used. Calculations were made with functions f(r) constructed in various ways. The trial functions depend on variational parameters, and the total energy is minimized with respect to these parameters. Also the "local energy" $H\psi/\psi$ is calculated. It is concluded that explicit trial functions can be more easily handled than trial functions constructed in other ways and give results of comparable or even better quality. (auth)

27521 DETERMINATION OF PHENOMENOLOGICAL alpha–alpha-POTENTIALS FROM SCATTERING DATA. **Benn, J.; Scharf, G. (Univ., Zurich). Helv. Phys. Acta, 40: 271-82 (1967).**

By means of the Gelfand–Levitan solution of the inverse problem in the scattering theory, α-α-interaction potentials were calculated from the experimental phase shifts. The potentials obtained in this way reproduce exactly the given phases. (auth)

27522 A SURVEY OF THE THEORY OF THE $\alpha(d,np)\alpha$ REACTION. Nakamura, H. (Aoyama Gakuin Univ., Tokyo). Phys. Lett., 24B: 509-11(May 15, 1967).

The data for the $\alpha(d,np)\alpha$ reaction obtained by Warner and Bercaw are analyzed by the use of the impulse approximation. (auth)

27523 THE MECHANISM OF THE $\alpha + d \rightarrow \alpha + p + n$ REACTION. Warner, R. E. (Oberlin Coll., Ohio); Bercaw, R. W. Phys. Lett., 24B: 517-19(May 15, 1967).

Coincidence measurements of absolute cross sections for the $\alpha + d \rightarrow \alpha + p + n$ reaction show large peaks due to final-state interactions through the ${}^5He$ and ${}^5Li$ ground states. Plane-wave impulse approximation calculations correctly predict the existence of additional peaks for small spectator neutron energies but otherwise give bad fits to the observed spectra. (auth)

Nuclear Properties and Reactions, $6 \leq A \leq 19$

Refer also to abstracts 26184, 25778, 25911, 27405, 27540, 27552, 27569, 27574, 27576–27579, 27628, 27646, 27650, and 27655.

27524 (CEA-R-3174) CONTRIBUTION A L'ETUDE DES NIVEAUX DU ${}^8Be$ OBTENUS A PARTIR DE LA REACTION ${}^6Li(d,\alpha)\alpha$. (Contribution to the Study of ${}^8Be$ Energy Levels Obtained During the Reaction ${}^6Li(d,\alpha)\alpha$). Tsan, Ung Chan (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Feb. 1967. 57p. (In French). Dep.

Thesis. Submitted to Grenoble Univ. (France). Faculte des Sciences.

The reaction ${}^6Li(d,\alpha)$ is interpreted using the theory of Humblet and Rosenfeld. This theory is briefly reviewed and is compared with that of Wigner. The intervention of the 4^+ level, indicated in the study of the reaction ${}^7Li(p,\alpha)$, is suggested. A good fit to the experimental data is obtained assuming the level scheme (0^+, 22.64 MeV), (4^+, 22.82 MeV), and (2^+, 24.97 MeV). However the scheme proposed by Mani (22.5 MeV, 2^+; 24.0 MeV, 0^+; 25.2 MeV, 2^+) on the basis of the Wigner theory, can not be rejected. (auth)

27525 (MIT-2098-307) POLARIZATION OF PHOTONEUTRONS FROM THE GIANT RESONANCE. **Hanser, Frederick A. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science). Apr. 1967. Contract AT(30-1)-2098. 238p. Dep. CFSTI.**

Thesis.

The polarization of photoneutrons from ${}^{16}O$, ${}^{12}C$, ${}^{40}Ca$, and ${}^{208}Pb$, emitted at 45 and 90° to various energy bremsstrahlung beams, was measured. The polarizations for ${}^{16}O$ are about −0.05 ± 0.02 at 90° and +0.50 ± 0.05 at 45°, for neutrons in the range of 5 to

10 MeV and for bremsstrahlung from 30-MeV electrons. Polarizations are along $\hat{k}_\gamma \times \hat{k}_n$, using the Basel convention for the sign. The 90° measurements indicate that the ^{16}O E1 giant resonance has some M1 and/or E2 contamination. Neglecting this contamination and assuming ground-state transitions to ^{15}O, the 45° polarization data and the angular-distribution results of Verbinski and Courtney can be fitted by about equal amounts of s- and d-wave neutrons with a relative phase difference of about 110°. The polarizations for ^{12}C are about 0.00 ± 0.05 at 90° and −0.20 ± 0.05 at 45°, for neutrons in the range of 3 to 10 MeV and for bremsstrahlung from 30-MeV electrons. These results and the angular-distribution results of Verbinski and Courtney can not be uniquely explained, as the E1 giant resonance for ^{12}C has three amplitudes for ground-state transitions to ^{11}C; and these amplitudes can fit the measurements in many ways. The results for ^{40}Ca give about 0.0 ± 0.1 at 90°. No polarization measurements were made at 45°. The ^{208}Pb results give about +0.16 ± 0.10 at 45° and 0.00 ± 0.10 at 90°. (auth)

27526 (SAL–6) THE INELASTIC SCATTERING OF ELECTRONS FROM ^{12}C. Beer, George Atherley (Saskatchewan Univ., Saskatoon. Saskatchewan Accelerator Lab.). Nov. 1966. 127p. Dep.

Thesis.

Measured values of the nuclear matrix element for the 19.4-MeV level in ^{12}C are presented, and the experimental equipment which was used for this investigation of nuclear structure by the technique of electron scattering is described. The matrix element for this level was measured in the previously uninvestigated region of momentum transfers between 120 and 220 MeV/c. All present measurements were made at the largest attainable scattering angle to enhance the transverse terms in the cross section. The experimental matrix elements were compared with theoretical results both for a 1^- and for a 2^- level predicted to lie in this energy region. These theoretical particle-hole calculations show that in the region of intermediate momentum transfers investigated, the magnitude of the matrix element is most sensitive to the spin-parity assignment. The 1^- matrix element has a minimum in this region whereas the 2^- matrix element has a maximum. The measured matrix elements are in satisfactory agreement with the particle-hole calculations for a 2^- level in ^{12}C, and the present values compare favorably with other measurements in the region of overlap. (auth)

27527 PRODUCTION OF ^{18}F BY SMALL RESEARCH REACTOR. Maruyama, Yoshiaki (Musashi Inst. of Tech., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 4: 185-9(Apr. 1967).

High-purity ^{18}F was prepared by irradiating 1 g of lithium hydroxide or otherwise 0.14 g of enriched lithium carbonate containing 50% ^{6}Li in the pneumatic tube of a TRIGA-II research reactor at a thermal neutron flux of 1.2×10^{12} n/cm^2·sec. After cooling for 20 min, the irradiated lithium hydroxide was dissolved in distilled water. The resulting ^{18}F was separated from the irradiated target by passing the lithium hydroxide solution successively through ion exchange columns of H-, OH-, and H-forms. Use was also made of the Co-form ion exchange column in place of the H-form for the elimination of impurities. In the case of ^{6}Li enriched lithium carbonate, the irradiated lithium carbonate was dissolved in hydrochloric acid, and ion exchange columns of Ag-, OH-, and H-forms were used for purifying the ^{18}F. The product ^{18}F was obtained in the form of water containing ^{18}F. The chemical yield for the purification of ^{18}F was about 80%, and the final radioactive impurities were less than 1 ppm. A neutron activation method for determining the isotopic abundance of ^{6}Li was developed using the nuclear reactions ^{6}Li(n,α)^{3}H and ^{16}O(t,n)^{18}F. Aqueous solutions containing lithium were irradiated in pneumatic tube for 1 hr. ^{18}F was separated by steam distillation from the irradiated solutions and precipitated as magnesium fluoride. The chemical yield for the separation of ^{18}F was about 80%. The sensitivity limit was estimated to be 4μg of natural lithium. (auth)

27528 INTERMEDIATE STRUCTURE IN ^{13}N. Scott, D. K.; Fisher, P. S.; Chant, N. S. (Nuclear Physics Lab., Oxford). Nucl. Phys., A99: 177-202(1967).

The reaction ^{12}C(p,p′)^{12}C* (15.11 MeV, 1^+, T = 1) has been studied over the incident energy range 20.5 to 30.3 MeV. In this region the excitation function for the reaction has resonances several hundreds of keV wide which suggests the presence of intermediate structure at this excitation in ^{13}N. The differential cross sections for the inelastically scattered protons show a change in the reaction from a direct to a compound-nuclear mechanism in a narrow energy range. The behavior of the cross sections is successfully explained using the DWBA theory and a three-quasi-particle model for the intermediate levels in ^{13}N. The following spins and parities for these "doorway" states are deduced with the theory of angular correlations: $5/2^+$ at 20.9 MeV; $5/2^-$ at 22.5 MeV; $3/2^-$ at 25.5 MeV. (auth)

27529 QUASI-DEUTERON PHOTODISINTEGRATION PROCESS IN LITHIUM, CARBON, AND CALCIUM. Smith, I. L.; Garvey, J.; Rutherglen, J. G.; Brookes, G. R. (Dept. of Natural Philosophy, Glasgow). Nucl. Phys., B1: 483-93(1967).

An experiment is described in which the quasi-deuteron photodisintegration process was studied in the nuclei ^{7}Li, ^{12}C and ^{40}Ca, for photons of energy between about 150 and 250 MeV. Angular distributions of protons of energy between about 60 and 130 MeV, produced in coincidence with neutrons of energy 74.9 ± 17.0 MeV (FWHM) emitted at 90° in the laboratory, were measured with a spark chamber, scintillation counter telescope. The neutrons were detected by a scintillation counter and their energies determined by a time-of-flight method. The form factor, F(P), defined as the probability of finding a neutron-proton pair of momentum P and zero separation in the ground state of the nucleus, is derived and used to determine the theoretical angular distributions. The cross section for the process is written as L(NZ/A)σ_d, where σ_d is the cross section for the photodisintegration of a deuteron and L is a constant. Comparison between theory and experiment leads to values of L for the three target nuclei in good agreement with that previously determined for oxygen, and also with that obtained by Bishop et al. (auth)

27530 USE OF FERMI-LIQUID METHOD IN THE CALCULATION OF PROBABILITY OF μ-MESON CAPTURE BY LIGHT NUCLEI. Rapoport, L. P.; Batkin, I. S. (Voronezh State Univ., USSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 30: 1325-9(Aug. 1966). (In Russian).

The partial transition probabilities for the reaction $\mu^- + {}^{16}\mathrm{O} \rightarrow {}^{16}\mathrm{N} + \nu$ was calculated using A. Fujii et al. (Progr. Theor. Phys. 32: 438, 1964) interaction Hamiltonians and the Fermi liquid theory for finite systems. The probability of μ^--capture was obtained by means of the Hamiltonian for meson(μ^-) weak interactions with nuclei. The theoretical and experimental data on partial probabilities are tabulated. The theoretical transition probability $W_{\mathrm{polar}}^{\mathrm{theor}} = 11.14 \times 10^3\ \mathrm{sec}^{-1}$; the total experimental probability $W_{\mathrm{polar}}^{\mathrm{exp}} = 9.15 \pm .09 \times 10^3\ \mathrm{sec}^{-1}$. The simple shell model produced results 50% higher than experimental. The tabulated data revealed the efficiency of the Fermi liquid method for estimating the influence of strong nucleon interactions in nuclei on the meson (μ^-) capture. (R.V.J.)

27531 TEST OF TIME-REVERSAL INVARIANCE IN THE BETA DECAY OF ^{19}Ne. Calaprice, Frank P. (Univ. of California, Berkeley); Commins, Eugene D.; Gibbs, Hyatt M.; Wick, Gerald L.; Dobson, David A. Phys. Rev. Lett., 18: 918-21 (May 22, 1967).

A test of T invariance in the mirror beta decay $^{19}\mathrm{Ne} \rightarrow {}^{19}\mathrm{F} + e^+ + \nu$ ($\tau_{1/2}$ = 18.5 sec) is reported. The experimental result gives no evidence for T invariance violation. (J.F.P.)

27532 A HIGH RESOLUTION MEASUREMENT OF THE ^{14}C(d,n)^{15}N REACTION. Lawergren, B.; Mitchell, I. V. (Atomic Energy Research Establishment, Harwell, Eng.). Nucl. Phys., A98: 481-8(1967).

Angular distributions of neutrons from the ^{14}C(d,n)^{15}N reaction were measured at E_d = 3.09 MeV using the time-of-flight technique. Transitions to all levels below 9.5 MeV in ^{15}N were observed and spectroscopic factors were extracted for transitions with l = 0 and l = 1 using DWBA analysis. From these factors, absolute spectroscopic factors are obtained with the aid of two independent sum rules. The only observed $s_{1/2}$ proton widths belong to the 5.30 and 9.06 MeV states. (auth)

27533 THE ^{6}Li(d,α)^{4}He REACTION AND STATES OF ^{8}Be BETWEEN 22 AND 32 MeV. Clark, G. J.; Sullivan, D. J.; Treacy, P. B. (Australian National Univ., Canberra). Nucl. Phys., A98: 473-80(1967).

Excitation functions and angular distributions for the ^{6}Li(d,α)^{4}He reaction were studied with beam energies between 3 and 12 MeV. Evidence is given for participation of ^{8}Be states at 27.5 MeV (4^-) and near 30 MeV (6^+). (auth)

27534 INELASTIC SCATTERING OF 14.6-MeV NEUTRONS TO EXCITED STATES OF ^{12}C. Turk, M. (Univ. of Zagreb). Z. Naturforsch., 22A: 411-13(Mar. 1967).

Angular distributions of 14.6-MeV neutrons inelastically scattered to the 9.64-, 10.84-, and 11.83-MeV levels of ^{12}C were measured by the nuclear emulsion technique. The distributions were compared with the theoretical distributions calculated on the basis of the Hauser-Feshbach model with transmission coefficients obtained from the optical-model potential. (auth)

27535 ELASTIC ALPHA-PARTICLE SCATTERING AT 8.75, 9.35, AND 10.15 MeV. Brady, F. P.; Jungerman, J. A.; Young, J. C. (Univ. of California, Davis). Nucl. Phys., A98: 241-62 (1967). (UCD-CNL–58).

The angular distributions of elastically scattered alpha particles were measured for the natural targets of Be, C, O, Al, Ca, and Ni at lab energies of 8.75, 9.35, and 10.15. Fairly good optical-model fits can be made except for ^{16}O and for ^{12}C at 10.15 MeV where an extra oscillation appears in the diffraction-like pattern. The energy dependence of the oxygen data is pronounced, and the optical model does not appear to be valid at these energies. The variation of best-fit, optical model parameters was studied with an automatic search routine. In the final analysis geometric parameters for a given nucleus were fixed at average values and a more or less consistent set of best-fit parameters was obtained for the three energies. However, the corresponding best-fit values of the real potential varied widely from nucleus to nucleus. For the three heaviest nuclei, the values of the radius parameter are larger and the diffuseness parameter smaller than reported at higher energies. (auth)

27536 THE REACTIONS ^{10}B(n,t)$\alpha\alpha$, ^{7}Li(n,t)αn, AND ^{6}Li(n,d)αn AT 14.4 MeV. Valkovic, V.; Slaus, I.; Tomas, P.; Cerineo, M. (Ruder Boskovic Inst., Zagreb). Nucl. Phys., A98: 305-22(1967).

The reactions ^{10}B(n,t)$\alpha\alpha$, ^{7}Li(n,t)αn and ^{6}Li(n,d)αn were studied at 14.4 MeV. The energy spectra indicate the importance of the sequential decay mechanism in these processes. The Phillips–Griffy–Biedenharn model gives a good fit to the data. No evidence of spatial localization was observed. (auth)

27537 HIGH-ENERGY PHOTODISINTEGRATION IN CARBON, OXYGEN, AND CALCIUM. Ferroni, S. (Ecole Normale Superieure, Orsay, France); Gracco, V.; Isabelle, D. B.; Malvano, R.; Sanzone, M. Nucl. Phys., A98: 409-16(1967).

The (γ,xn) cross section for carbon, oxygen and calcium was measured for photon energy between 100 and 150 MeV. Comparison of the results with an independent-pair model indicates that a pair correlation function should be taken into account while the interaction between nucleons in the final state seems to be negligible for C and O. (auth)

27538 γ–NEUTRINO CORRELATIONS IN ALLOWED NUCLEAR μ-MESON CAPTURE. Bukhvostov, A. P.; Popov, N. P. (Ioffe Inst. of Physics and Tech., Leningrad). Phys. Lett., 24B: 497-9(May 15, 1967).

Angular $\gamma\nu$ correlation and circular polarization of γ-ray quanta are calculated for allowed capture of unpolarized μ-meson with arbitrary population of μ-mesic atom hyperfine levels. (auth)

27539 REACTION ^{13}C(d,α)^{11}B. Klyucharev, A. P.; Titov, Yu. I.; Vypirailenko, V. D. (Kharkov State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz., No. 3, 104-6(1966). (In Russian).

The possibility of direct processes (as the knockout of an α particle) in nuclei with cluster structure was studied in the ^{13}C(d,α)^{11}B reaction. From the point of view of the cluster model the probable structure of ^{13}C should be (3α + n). In such a case the capture of deuterons is rather improbable. However, the differential cross section curves at small angles indicate direct processes have taken place in the reactions with energies exceeding the Coulomb barrier. Alpha particle spectra from ^{13}C + d reactions at 25 and 85° angles at 1.2 and 2.14 MeV are given. The excitation function of the ^{13}C(d,α)^{11}B reaction measured at 90° angle exhibited two weakly defined peaks at deuteron energies 1.2 and 1.4 MeV. The asymmetry of the angular distribution in relation to the 90° angle indicates that the reaction cannot be fully described by the compound nuclear model. (R.V.J.)

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Refer also to abstracts 25915, 26184, 26186, 26169, 26865, 27525, 27529, 27535, 27537, 27567, 27569, 27570, 27572, 27574, 27576–27579, 27593, 27597, and 27605.

27540 (UCRL–14002) THRESHOLDS FOR DEUTERON-INDUCED REACTIONS. Howerton, R. J.; Braff, Donald; Cahill, W. J.; Chazan, Nanette (California Univ., Livermore. Lawrence Radiation Lab.). Sept. 3, 1964. Contract W-7405-eng-48. 48p. Dep. CFSTI.

This tabulation of thresholds for deuteron-induced reactions, in the laboratory system, was derived from the tabulation of binding energies given by König et al. No error analysis was attempted since it is felt that persons wanting a detailed analysis should properly consult König et al. and the references contained therein. This tabulation is primarily for those who need a ready reference. The definition of the threshold used here is: the minimum kinetic energy of an impinging neutron (in the laboratory system) such that the reaction is energetically possible. In view of this definition, all reactions having a positive Q-value have a threshold of zero. Those reactions having a negative Q-value have a threshold of $-[(A + 2)/A]Q$. For those reactions for which the binding energy of the residual nucleus is not given in König et al. dashes are entered in the table. (auth)

27541 THE ELASTIC AND INELASTIC SCATTERING OF 30.4-MeV PROTONS BY ^{54}Fe. Baugh, D. J.; Kenny, M. J.; Lowe, J.; Watson, D. L.; Wojciechowski, H. (Univ. of Birmingham, Eng.). Nucl. Phys., A99: 203-12(1967).

Differential cross sections and polarizations are presented for the elastic scattering of 30.4-MeV protons by ^{54}Fe and for inelastic scattering to the 1.41-, 4.8-, and 6.4-MeV states. The results for the 1.41-MeV state are compared with DWBA calculations. Unlike the cross sections, the predicted polarizations are in poor agreement with experiment when shell-model wave functions are used. A collective-model description gives fair agreement with experiment provided a sufficiently large deformation parameter is used for the spin-orbit potential. (auth)

27542 RESONANCES IN THE ^{30}Si(p,γ)^{31}P REACTION BETWEEN 2 AND 3 MeV. Bornman, C. H.; Meyer, M. A.; Reitmann, D. (Atomic Energy Board, Pelindaba, South Africa). Nucl. Phys., A99: 337-44(1967).

Proton capture resonances in ^{30}Si were studied in the energy range E_p = 2 to 3 MeV. A total of 54 resonances was observed, and the energies and strengths were determined. The gamma decay schemes of 31 of the resonances were investigated by means of pulse-height spectra and sum-coincidence measurements with NaI(Tl) scintillation counters. (auth)

27543 HYPERFINE STRUCTURE INVESTIGATIONS WITH THE MOESSBAUER EFFECT FOLLOWING THE REACTION ^{56}Fe(d,p)^{57}Fe. Christiansen, J.; Hindennach, P.; Morfeld, U.; Recknagel, E.; Riegel, D.; Weyer, G. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Nucl. Phys., A99: 345-52(1967).

The Mössbauer effect of the 14.4-keV γ rays of ^{57}Fe was investigated following the reaction ^{56}Fe(d,p)^{57}Fe. The hyperfine structure spectra of a metallic iron target did not show any indication of lattice perturbations in the vicinity of the excited recoil. A measurement of the microscopic temperature in the surrounding of recoils, stopped at a normal lattice site, was performed using the temperature dependence of the magnetic hyperfine splitting and the Josephson shift of the spectra. In the case of target temperatures of +40°C and –195°C, the values were shown to be equal to the macroscopic ones within 30 and 25°C, respectively, at the time of deexcitation of the Mössbauer level. (auth)

27544 MOESSBAUER SPECTRA WITH SOURCE AND ABSORBER AT REST RELATIVE TO EACH OTHER. Nielsen, A.; Olsen, J. (Danish Atomic Energy Commission, Roskilde, Denmark). Nucl. Instrum. Methods, 52: 173-4(June 1967).

The Doppler shift can be achieved by means of a Bragg reflection in a crystal which is moved with a velocity v. The relative frequency shift is given by $(v/c)(\lambda/d)$, where λ is the wavelength of the gamma ray and d is the lattice distance. (auth)

27545 MEASUREMENT OF THE MOESSBAUER EFFECT ON ^{57}Fe WITH A SCATTERING GEOMETRY BY RECORDING 14.4 keV RADIATION. Artem'ev, A. N.; Sklyarevskii, V. V.; Smirnov, G. V.; Stepanov, E. P. Zh. Eksp. Teor. Fiz., 52: 1157-9 (May 1967). (In Russian).

Various methods for measuring the Mössbauer effect on ^{57}Fe with a scattering geometry are compared. It is demonstrated that sufficiently large effects can be obtained on thick unenriched samples. (auth)

27546 LOW-LYING ^{46}Sc EXCITATION LEVELS APPEARING IN ^{45}Sc(n,γ)^{46}Sc REACTIONS. Berestovoi, A. M.; Kondurov, I. A.; Loginov, Yu. E. Izv. Akad. Nauk SSSR, Ser. Fiz., 30: 1277-80 (Aug. 1966). (In Russian).

The nature of certain low-lying (below 0.9 MeV) levels of ^{46}Sc was determined on the basis of data on the cascade γ transitions in radiative neutron capture and other data on other reactions. A $\gamma\overline{\gamma}$ coincidence spectrometer using NaI(Tl) crystal detectors with photomultipliers and germanium counters were used. The spectrum of ^{46}Sc recorded by Ge(Li) counters is given, and the decay scheme of the low-lying ^{46}Sc levels is included. The experiments did not find any noticeable γ transitions related to proton-hole excitation of ^{46}Sc nuclei. (R.V.J.)

27547 TRITON REACTIONS WITH ^{30}Si. PART 3. DETERMINATION OF THE ^{32}Si HALF-LIFE. Jantsch, K. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie, 10: 89-91(Mar. 1967). (In German).

The half life of ^{32}Si is determined by using two methods. In the first case the cross sections of the nuclear reactions ^{30}Si(t,p)^{32}Si and ^{36}Mg(t,p)^{28}Mg are assumed to be equal to each other. Then, from the absolute activities of ^{32}Si and ^{28}Mg produced in a LiSiMg alloy irradiated with neutrons and the well-known half life of ^{28}Mg, one obtains the ^{32}Si half life of 280 yr. Secondly, the half life of ^{32}Si was calculated from the ratio of the cross sections of the reactions ^{30}Si(t,n)^{32}P and ^{30}Si(t,p)^{32}Si, provided that it takes the same value of 6.4 : 1 as that of the nuclear reactions ^{63}Cu(t,n)^{65}Zn and ^{65}Cu(t,p)^{67}Cu determined by Kundu and Pool. Using both the above assumption and the experimental results for the reactions ^{30}Si(t,n)^{32}P and ^{30}Si(t,p)^{32}Si, the half life of ^{32}Si becomes 286 yr. (auth)

27548 THE (0$^+$) → (0$^+$) POSITON DECAY OF ^{66}Ga. van Neste, L.; Coussement, R.; Deutsch, J. P. (Louvain Univ., Belg.). Nucl. Phys., A98: 585-98(1967).

The spectrum shape of the ground state to ground state decay of ^{66}Ga was measured with an iron-free, thin-lens, beta spectrometer. As this (0$^+$) → (0$^+$) transition is strongly hindered by the isospin selection rule, second-forbidden contributions were taken into account in order to fit the non-statistical spectrum shape obtained. From the values of the second-forbidden matrix elements in agreement with both our result and the ft value, the value of the Fermi matrix element and that of the isospin impurity of ^{66}Ga were extracted. The isospin-impurity parameter was found to be $1.12 \times 10^{-5} < (\alpha_{32})^2 < 1.35 \times 10^{-5}$. The spectrum shape can be fitted by the expression of the spectrum shape factor containing second-forbidden contributions without any phenomenological correction factor of the (1 + b/W) type. (auth)

27549 THE ELECTRON CAPTURE DECAY OF ^{40}K. McCann, M. F.; Lewis, G. M.; Smith, K. M. (Glasgow Univ.). Nucl. Phys., A98: 577-84(1967).

The Auger and K x-ray electron capture peak of ^{40}K has been observed, free from source absorption and background effects, using internal-source scintillation-counter methods. The (L + M + N)/K electron capture ratio was determined to be 0.34 ± 0.08. Comparison with theoretical values for a first-forbidden unique decay indicates a transition energy for ^{40}K to the 1.46-MeV excited state of ^{40}Ar of 41 keV. This figure is compared with mass difference determinations by other methods and agreement exists within the present uncertainties of the methods. The log ft value corresponding to this energy is 10.1 ± 0.2 and is consistent with the first-forbidden unique assignment for the decay. (auth)

27550 CROSS SECTIONS OF SOME REACTIONS OF Ar, Ti, Ni, Cd, AND Pb WITH 14.1 MeV NEUTRONS. Yu, Yu-wen; Gardner, Donald G. (Illinois Inst. of Tech., Chicago). Nucl. Phys., A98: 451-9(1967).

The following reaction cross sections were measured using the activation method: ^{40}Ar(n,α)^{37}S, 31 ± 5 mb; ^{48}Ti(n,α)^{45}Ca, 39 ± 6 mb; ^{50}Ti(n,α)^{47}Ca, 9.4 ± 3 mb; ^{62}Ni(n,α)^{59}Fe, 22 ± 3 mb; ^{106}Cd(n,α)^{103}Pd, 100 ± 40 mb; ^{108}Cd(n,2n)^{107}Cd, 504 ± 75 mb; ^{110}Cd(n,p)^{110}Ag, 27 ± 5 mb; ^{111}Cd(n,p)^{111}Ag, 14 ± 1.4 mb; ^{112}Cd(n,α) × ^{109}Pd, 2.4 ± 0.4 mb; ^{112}Cd(n,p)^{112}Ag, 11 ± 1 mb; ^{113}Cd(n,p)^{113}Ag, 7.9 ± 0.8 mb; ^{114}Cd(n,α)^{111m}Pd, 0.2 ± 0.03 mb; ^{114}Cd(n,α)^{111g}Pd, 0.5 ± 0.08 mb; ^{116}Cd(n,α)^{113}Pd, 0.5 ± 0.5 mb; ^{116}Cd(n,p)^{116}Ag, 0.2 ± 0.1 mb; ^{116}Cd(n,2n)^{115m}Cd, 730 ± 60 mb; ^{116}Cd(n,2n)^{115g}Cd, 857 ± 70 mb; and ^{206}Pb(n,α)^{203}Hg, 2.7 ± 0.5 mb. The results were found to be in fairly good agreement with the semi-empirical predictions of Gardner, Yu, and Rosenblum. (auth)

27551 MEASUREMENTS OF THE ENERGY LEVEL STRUCTURE OF Ni ISOTOPES USING (d,p) AND (p,p') REACTIONS. Tee, R. G.; Aspinall, A. (Univ. of Bradford, Eng.). Nucl. Phys., A98: 417-36(1967).

New data on the energy levels of ^{58}Ni, ^{60}Ni, ^{61}Ni, ^{62}Ni, ^{63}Ni, ^{64}Ni, and ^{65}Ni were obtained from a study of (d,p) and (p,p$'$) reactions with the naturally occurring isotopes of nickel. The data reported are used to obtain information on the variation of the single-particle level density near the closed neutron shell. The data are then used, together with data of others on isotones of the even nickel isotopes, to investigate the variation of the single-particle level density near the closed proton shell. (auth)

27552 PROPERTIES OF THE 7.02-MeV AND 10.65-MeV LEVELS ^{20}Ne. Smulders, P. J. M.; Broude, C.; Litherland, A. E. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys., 45: 2133-43(June 1967). (AECL-2896).

The 7.02-MeV level of ^{20}Ne was studied by the ^{12}C(^{12}C,$\alpha\gamma$)^{20}Ne reaction, using angular correlation techniques, with a particle counter and six NaI crystals. The spin and parity of this level were determined to be 4$^-$. The branching ratio of the decays to the 5.63, 4.97, and 4.25 MeV levels was found to be 22 : 65 : 13. The transition to the 5.63-MeV state (4$^-$ → 3$^-$) is an almost pure E2 transition with an M1/E2 amplitude ratio of 0.03 ± 0.03. The branching ratio of the E2 transitions to the 5.63-MeV 3$^-$ level and the 4.97-MeV 2$^-$ level is in excellent agreement with predictions from the rotational model and also with SU$_3$ calculations. Similar measurements on the 10.65-MeV level in ^{20}Ne support the tentative 6$^-$ assignment to this level. (auth)

27553 ON FISSION TECHNETIUM. III. 5-sec ^{102}Tc. von Baeckmann, A. (Kernforschungszentrum, Karlsruhe, Ger.). Radiochim. Acta, 7: 1-3(Mar. 1967). (In German).

The half life of ^{102}Tc was determined to be 5.28 ± 0.15 sec by means of fast chemical separation making use of extraction of tetrabutylammoniumiodide in bromoform. In order to record the γ spectrum the ^{102}Tc was continuously separated from fission-molybdenum, which was fixed as phosphormolybdenic acid on an anion exchange column. Eight normal HNO$_3$ was used as eluting solvent. Strong lines were observed at 0.475, 0.630, 0.865, and 1.11 MeV. Weaker lines were visible corresponding to energies up to 2.45 MeV. (auth)

27554 AMBIGUITIES IN THE OPTICAL-MODEL ANALYSIS OF ALPHA-PARTICLE SCATTERING. Thompson, W. J.; Crawford, G. E.; Davis, R. H. (Florida State Univ., Tallahassee). Nucl. Phys., A98: 228-40(1967).

The phase-equivalent discrete ambiguities in the complex potential parameters which are obtained from optical-model analysis of alpha-particle elastic scattering differential cross sections are examined. A detailed analysis of the scattering of 10.8-MeV alpha particles by ^{24}Mg is used to illustrate the discussion of these ambiguities. In principle, one technique for the reduction of the ambiguities is the coupled-equations analysis of two or more channels, and this is applied to the example data. Cluster-model information about the bound states also provides a basis for a choice. These analyses suggest that the real part of the optical-model potential for alpha particles is between 150 and 200 MeV. (auth)

27555 THE DECAY OF 3.2-min ^{89}Kr. Kitching, J. E.; Johns, M. W. (McMaster Univ., Hamilton, Can.). Nucl. Phys., A98: 337-64(1967).

Ge(Li) detector measurements, together with $\beta\gamma$ and $\gamma\gamma$ coincidence experiments using NaI(Tl) and plastic beta detectors, led to the classification of 82 gamma rays following the decay of 3.2-min ^{89}Kr and to a decay scheme involving 34 levels in ^{89}Rb. The decay of ^{89}Kr proceeds mainly through levels at 0.2206, 0.4977, 0.5771, 0.5864, 0.9975, 1.324, 1.533, 1.692, 1.760, 1.998, 2.161, 2.400, 2.596, 2.866, 3.364, 3.534, and 3.720 MeV. Since the highest energy beta transition of 4.93 ± 0.03 MeV feeds the 0.2206-MeV level, the Q value is 5.15 ± 0.03 MeV. (auth)

27556 ENERGY LEVELS OF ^{23}Na AND ^{23}Mg. Hay, H. J.; Kean, D. C. (Australian National Univ., Canberra). Nucl. Phys., A98: 330-6(1967).

Many previously unreported levels in ^{23}Na and ^{23}Mg were found by magnetic analysis of the α particles from the ^{25}Mg(d,α)^{23}Na and ^{24}Mg(^{3}He,α)^{23}Mg reactions. The corresponding levels in these mirror nuclei are identifiable up to nearly 6-MeV excitation. The level schemes between 4- and 6-MeV excitation are briefly discussed. (auth)

27557 THE HALF-LIFE AND MASS OF ^{43}Ti. Aldridge, A. M.; Plendl, H. S.; Aldridge III, J. P. (Florida State Univ., Tallahassee). Nucl. Phys., A98: 323-9(1967).

The mass and beta-decay half life for ^{43}Ti were measured using the ^{40}Ca(α,n)^{43}Ti reaction. The mass excess (^{12}C scale) was determined to be −29325 ± 15 keV from a value of 12290 ± 10 keV for the reaction threshold. The corresponding beta end-point energy was calculated to be 5.83 ± 0.02 MeV. The half life of ^{43}Ti was measured to be 0.49 ± 0.01 sec. The corresponding log ft value is 3.47 ± 0.03. (auth)

27558 THE INTERACTION OF ^{48}Ca WITH 17 TO 39 MeV ALPHA PARTICLES. Gordon, B. M. (Brookhaven National Lab., Upton, N. Y.). Contract AT(30-2)-Gen-16. Nucl. Phys., A98: 403-8(1967). (BNL-11061).

Excitation functions were determined for the (α,αn), (α,p2n) and (α,p3n) reactions of neutron-excess ^{48}Ca with 17 to 39 MeV alpha particles. These results are compared with evaporation calculations. The experimental excitation function for the (α,αn) reaction does not fall off rapidly on the low-energy side indicating a substantial contribution from a low-energy direct-interaction mechanism. The cross section at the maximum of the excitation function is approximately twice the calculated value. The possible relevance to these observations of recently published data concerning the charge distribution in ^{48}Ca nuclei is discussed. The measured yields for the (α,p2n) and (α,p3n) reactions are consistent with a compound-nucleus mechanism. (auth)

27559 PROTON ELASTIC SCATTERING AT 61.4 MeV. Fulmer, C. B. (Oak Ridge National Lab., Tenn.); Ball, J. B.; Scott, A.; Whiten, M. L. Contract W-7405-eng-26. Phys. Lett., 24B: 505-7(May 15, 1967). (ORNL-P-2873).

Differential cross sections for elastic scattering of 61.4 MeV protons by ^{27}Al, ^{58}Ni, ^{90}Zr, ^{116}Sn, and ^{208}Pb were measured at 2° intervals between 20 and 112°. Some results of optical model analysis of these data are discussed. (auth)

27560 THE ENERGY, LIFETIME, AND SPIN OF THE 1611-keV LEVEL IN ^{37}Ar. Goosman, D. R.; Kavanagh, R. W. (California Inst. of Tech., Pasadena). Contract Nonr-220(47). Phys. Lett., 24B: 507-9(May 15, 1967).

The energy of the second excited state of ^{37}Ar was measured to be 1611 ± 1 keV. The half life was determined by a recoil-Doppler-shift method to be 5.15 ± 0.7 ns, confirming the spin and parity of this level as $\frac{7}{2}^-$. (auth)

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Refer also to abstracts 25902, 26174, 26186, 26865, 27525, 27540, 27550, 27559, and 27654.

27561 (ANL-7288) FAST NEUTRON SCATTERING FROM THE 182, 184, AND 186 ISOTOPES OF TUNGSTEN. Lister, D.; Smith, A. B. (Argonne National Lab., Ill.); Dunford, C. (Atomics International, Canoga Park, Calif.). Jan. 1967. Contract W-31-109-eng-38. 32p. Dep. CFSTI.

The differential cross sections for the elastic and inelastic scattering of fast neutrons from ^{182}W, ^{184}W, and ^{186}W were experimentally determined at incident neutron energy intervals of $\lesssim$25 keV from 0.3 to 1.5 MeV. The excitation, by inelastic scattering, of states in ^{182}W at 102 ± 5 and 327 ± 10 keV; in ^{184}W at 110 ± 5, 360 ± 10, 901 ± 10, 1003 ± 10, and 1120 ± 10 keV; and in ^{186}W at 121 ± 5, 398 ± 10, 738 ± 10, 863 ± 10, 942 ± 10, and 1035 ± 10 keV was observed. The differential elastic and inelastic scattering cross sections were measured at eight or more angles between 27 and 150° by means of a multiangle, fast time-of-flight system. The resolution was sufficient to resolve most of the scattered neutron groups. The experimental results were interpreted in terms of a deformed optical model, coupled-channel direct interaction, and Hauser-Feshbach theory. Good agreement with measurement was obtained when the effects of resonance width fluctuations and correlations were included. (auth)

27562 (BMwF-FBK-67-20) UNTERSUCHUNG DER γ-STRAHLUNG BEI EINFANG THERMISCHER NEUTRONEN IN ^{123}Te MIT DER SUMMENKOINZIDENZMETHODE. (Investigation of γ-Radiation Resulting From Thermal Neutron Capture in ^{123}Te by the Sum-coincidence Method). Zehender, O. (Erlangen Univ. (West Germany). Physikalisches Institut). Mar. 1967. 10p. (In German). Dep.

Two-step cascades and coincident γ rays from multi-step cascades from the capturing state to the ground state of ^{124}Te were investigated by means of the sum-coincidence method. The relative intensities of the cascades found were determined. (auth)

27563 (CNEA-175) DOS NUEVOS RADIOISOTOPOS DE RENIO Y TUNGSTENO. (New Rhenium and Tungsten Radioisotopes). Baro, G. B.; Flegenheimer, J.; Viirsoo, M. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1966. 24p. (In Spanish). Dep.

The nuclides ^{189}W and ^{190m}Re were produced, and their decay characteristics were investigated, while the existence of the recently discovered ^{189}Re was confirmed. ^{189}W was produced by (n,α) reactions on natural osmium enriched in ^{192}Os. Its half-life is 11 ± 1 min, and it decays by beta emission, with a maximum beta energy of about 1.4 MeV. ^{190m}Re was produced by (n,p) reactions on natural osmium and on osmium enriched in ^{190}Os, and by (d,α) reactions on enriched ^{192}Os. Its half life is 2.8 ± 0.2 hr and its maximum beta energy about 1.5 MeV. Gamma lines of 60, 120, 190, 230, 380, 560 and 820 keV were observed. By Szilard-Chalmers process it was investigated whether ^{190m}Re decays to its 3-min isomer. These tests were unsuccessful. ^{189}Re, produced by (d,αn) reaction on ^{192}Os, by (n,p) reactions on ^{189}Os, and by (n,np) reactions on ^{190}Os, has a half life of 23 ± 1 hr. Its maximum beta-ray energy is about 0.8 MeV. Gamma lines of 65, 140, 170 and 225 keV were observed. (auth)

27564 (EIR-104) L'EFFET DE FISSION PAR LES NEUTRONS RAPIDES DANS DES RESEAUX DE GRAPPES. (Effects of Fission by Fast Neutrons on Cluster Lattices). Rognon, J. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen (Switzerland)). Dec. 1966. 111p. (In French). Dep. mn.

A theory is constructed which makes it possible to determine the fission ratio δ^{28} for all the characteristic regions of a cluster and the fast fission factor for the cluster ensemble. The theory is based on the concept of the microcell and follows the physical phenomena as far as possible. It permits a local comparison with experience for each characteristic ring of the cluster. The effect of the moderator is considered in calculating the effects of back-scattering and of cluster-cluster interaction. A new definition of the fast fission factor is proposed. The EPSICH code based on this theory calculates a complete example in less than 0.5 sec. (J.S.R.)

27565 (INP-535/PL) PARTIAL HALF-LIVES OF ALPHA DECAY OF ^{151}Tb AND ^{149}Tb NUCLEI. Kormicki, Jan; Niewodniczanski, Henryk; Stachura, Zbigniew; Zuber, Kazimierz; Budziak, Alicja (Institute of Nuclear Physics, Krakow (Poland)). Mar. 1967. 17p. Dep.

The alpha branching ratios ($\lambda_\alpha/\lambda_{tot}$) and partial half lives of alpha decay for ^{151}Tb and ^{149}Tb were determined. The alpha branching ratios were obtained by the determination of the ratio of intensities of suitably chosen electron-conversion lines in Gd and Eu nuclei produced from ^{151}Tb and ^{149}Tb nuclei by electron capture and alpha decay, respectively. The obtained values of ($\lambda\alpha/\lambda_{tot}$) are $5 \pm 1.5 \times 10^{-6}$ for ^{151}Tb and $2 \pm 0.6 \times 10^{-1}$ for ^{149}Tb. Alpha reduced widths δ^2 and hindrance factors F were calculated. (auth)

27566 (INR-776/I/PL) BADANIA MECHANIZMU REAKCJI WYWOLANYCH PRZEZ NEUTRONY PREDKIE. (Investigations of the Mechanism of Fast Neutron-Induced Reactions). Wilhelmi, Z. (Institute of Nuclear Research, Warsaw (Poland)). 1967. 64p. (In Polish). Dep.

The status of research on reaction mechanisms is summarized, and the results of some research are presented. 75 references. (D.C.W.)

27567 (JAERI-1124) GAMMA-RAY SPECTRA OF FISSION PRODUCTS. Kamemoto, Y. (Japan Atomic Energy Research Inst., Tokyo). Sept. 1966. 43p. (In Japanese). Dep.

A collection of the gamma-ray spectrograms for 76 different fission products with half lives longer than a few minutes, for uranium-239, and for neptunium-239 is presented. Half life, absorber, gamma-ray detector, geometry, decay scheme, etc., are indicated on each spectrogram. (auth)

27568 (LA-3676) THE ^{233}U FISSION AND CAPTURE CROSS SECTIONS AND THEIR ANALYSIS AT LOW ENERGIES. Bergen, Delmar W. (Los Alamos Scientific Lab., N. Mex.). Dec. 1966. Contract W-7405-eng-36. 76p. Dep. CFSTI.

Thesis. Submitted to Univ. of New Mexico [Albuquerque].

The ^{233}U fission and capture cross sections were measured using a nuclear-device neutron source and time-of-flight techniques. Cross section data are presented from 20 to 10^6 eV for fission and from 20 to 63 eV for fission + capture. The resonance region (20 eV to 63 eV) was fitted with both a single-level function consisting of a sum of Breit-Wigner levels and the Reich and Moore multilevel function based on R-matrix theory. The resulting resonance parameters are listed and discussed. In order to establish the validity of the resonance parameters derived from the multilevel fit, a study is presented of the cross section derived from two and three hypothetical resonances under various conditions and of the cross sections obtained from randomly generated resonances. (auth)

27569 (MIT-2098-299, pp 19-34) LINEAR ACCELERATOR GROUP. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science).

Differential cross sections for ^{9}Be(γ,n)^{8}Be reactions at 2.5 to 15 MeV were measured, and angular distributions were derived. Energy spectra and angular distributions of photoneutrons from heavy elements were measured at 24, 76, and 156° relative to the photon beam; bremsstrahlung spectra with endpoints of 13, 14, and 15 MeV were used. The polarizations of photoneutrons from ^{40}Ca, ^{12}C, D, ^{208}Pb, and ^{16}O were also measured, as was the angular distribution of the polarization of 14.7-MeV neutrons elastically scattered by ^{12}C. Photoproton spectra from ^{6}Li at bremsstrahlung endpoint energies of 95 and 102 MeV were obtained in a study of shell effects. (D.C.W.)

27570 (MIT-2098-299, pp 52-65) O.N.R. GENERATOR GROUP. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science).

A number of (d,p) and (He-3,p) reactions were investigated; the experimental data were analyzed using the distorted-wave Born approximation. The ^{3}He^{2+} ion source was modified to provide a beam of 0.1 μamp on target in the ONR generator. (D.C.W.)

27571 (MIT-2098-299, pp 66-73) RADIOACTIVITY GROUP. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science).

The gyromagnetic ratios of 2$^+$ states in the even-even Te isotopes were measured using the method of perturbed angular correlations after Coulomb-excitation ion implantation. The internal magnetic fields at Pb and Os nuclei in iron lattices were measured, and the gyromagnetic ratio of the 2$^+$ state of ^{192}Os was determined. The isomer shift of the 122-keV state in ^{152}Sm was measured by Moessbauer effect experiments between 2$^+$ and 3$^+$ valence states. The stripping of electrons from Br, I, Ta, and U ions on passing through foils and gases was investigated. The alpha branching ratio of ^{227}Ac to ^{223}Fr was measured, and the spins of levels in ^{223}Ra and ^{219}Rn were determined by $\alpha-\gamma$ angular correlation measurements of ^{227}Th decay and ^{223}Ra decay, respectively. The total internal conversion coefficient of the first excited level in ^{224}Ra was measured. (D.C.W.)

27572 (MIT–2098-299, pp 74-82) CYCLOTRON GROUP. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science).

The energy levels of ^{64}Ni, ^{48}Ti, and ^{90}Zr were investigated by alpha inelastic scattering. Differential cross sections were measured for the ^{42}Ca(p,d)^{41}Ca reaction at 26 MeV; the results were compared with the predictions of the distorted-wave Born approximation. Computer programs were written for the reduction of gamma spectra and were used to fit spectra obtained experimentally in a study of level transitions in ^{42}Ca and ^{48}Ca. (D.C.W.)

27573 (MLM–699) CALORIMETRIC INVESTIGATION OF THE HALF LIFE OF POLONIUM. Anger, D.; Eichelberger, J. F. (Mound Lab., Miamisburg, Ohio). Aug. 20, 1952. Contract AT(33-1)-Gen-53. 16p. Dep. CFSTI.

A steady-state resistance-bridge calorimeter was constructed especially for an exact measurement of the half life of polonium. The maximum heat distribution error of this calorimeter is of the order of 0.15% so that the half life should be determinable to about 0.02%. The necessary potential and current measurements were made with a Wenner Potentiometer and National-Bureau-of-Standards-Type Resistors, all accurate to 0.01% and considerably more precise. Nineteen measurements were made over a period of 271 days. The method of least squares was applied to these data and gave a value of 138.391 ± 0.023 days for the half life of polonium. (auth)

27574 (NYO-GEN-132) PEGRAM NUCLEAR PHYSICS LABORATORIES PROGRESS REPORT, JANUARY 1966–JANUARY 1967. (Columbia Univ., New York. Dept. of Physics). Contract AT-30-1-GEN-72. 211p. Dep. CFSTI.

72575 (UCRL–13260) FISSION FRAGMENT ANALYZER STUDY. Final Report. Cambey, L. A.; Smith, T. C. (Nuclide Corp., State College, Pa.). Dec. 29, 1966. Contract W-7405-eng-48. 48p. Dep. CFSTI.

For California Univ., Livermore. Lawrence Radiation Lab.

The results obtained from the drift-tube experiments with three phase ac voltages showed general agreement with theoretical predictions. If conical electrodes are to be used, it will be necessary to determine the optimum angle for which the increase in intensity due to restoring fields counteracts the attenuation due to fringing fields and diffusion broadening. However, further experimental work is required to increase our understanding of the device. Evidence of possible interconversion of ionic species was observed despite the precautions to preserve ultrahigh purity gas conditions throughout. The overall efficiencies of the test devices used were sufficiently high to indicate the required efficiency for transferring charged fission fragments through a beam port hole may well be attainable. (auth)

27576 (UCRL–14001) THRESHOLDS FOR PROTON-INDUCED REACTIONS. Howerton, R. J.; Braff, Donald; Cahill, W. J.; Chazan, Nanette (California Univ., Livermore. Lawrence Radiation Lab.). Sept. 2, 1964. Contract W-7405-eng-48. 47p. Dep. CFSTI.

This tabulation of thresholds for proton-induced reactions, in the laboratory system, was derived from the tabulation of binding energies given by König et al. No error analysis was attempted since it is felt that persons wanting a detailed analysis should properly consult König et al. and the references contained therein. This tabulation is primarily for those who need a ready reference. The definition of the threshold used here is: The minimum kinetic energy of an impinging neutron (in the laboratory system) such that the reaction is energetically possible. In view of this definition, all reactions having a positive Q value have a threshold of zero. Those reactions having a negative Q value have a threshold of –[(A + 1)/A]Q. For those reactions for which the binding energy of the residual nucleus is not given in König et al. dashes are entered in the table. (auth)

27577 (UCRL–14004) THRESHOLDS OF ^{3}He INDUCED REACTIONS. Howerton, R. J.; Braff, Donald; Cahill, W. J.; Chazan, Nanette (California Univ., Livermore. Lawrence Radiation Lab.). Sept. 14, 1964. Contract W-7405-eng-48. 50p. Dep. CFSTI.

This tabulation of thresholds for ^{3}He-induced reactions, in the laboratory system, was derived from the tabulation of binding energies given by König et al. No error analysis was attempted since it is felt that persons wanting a detailed analysis should properly consult König et al. and the references contained therein. This tabulation is primarily for those who need a ready reference. The definition of the threshold used here is: the minimum kinetic energy of an impinging particle (in the laboratory system) such that the reaction is energetically possible. In view of this definition, all reactions having a positive Q value have a threshold of zero. Those reactions having a negative Q value have a threshold of –[(A + 3)/A]Q. For those reactions for which the binding energy of the residual nucleus is not given in König et al. dashes are entered in the table. (auth)

27578 (UCRL–14005) THRESHOLDS FOR ^{4}He INDUCED REACTIONS. Howerton, R. J.; Braff, D. L.; Cahill, W. J.; Chazan, Nanette (California Univ., Livermore. Lawrence Radiation Lab.). July 1964. Contract W-7405-eng-48. 48p. Dep. CFSTI.

This tabulation of thresholds for ^{4}He-induced reactions, in the laboratory system, was derived from the tabulation of binding energies given by König et al. No error analysis was attempted since it is felt that persons wanting a detailed analysis should properly consult König et al. and the references contained therein. This tabulation is primarily for those who need a ready reference. The definition of the threshold used here is: the minimum kinetic energy an impinging alpha particle (in the laboratory system) must have to make the reaction energetically possible. In view of this definition, all reactions having a positive Q-value have a threshold of zero. Those reactions having a negative Q-value have a threshold of –[(A + 4)/A]Q. For those reactions for which the binding energy of the residual nucleus is not given in König et al., dashes are entered in the table. (auth)

27579 (UNC–5099) NEUTRON CROSS SECTIONS OF ^{238}U, ^{235}U, ^{237}U, ^{239}U, ^{234}U, ^{236}U, ^{239}Pu, ^{240}Pu, W, Pb, Ni, Cr, C, ^{6}Li, ^{7}Li, AND T. Bertin, M. C.; Celnik, J.; Flesher, H.; Grochowski, G.; Kalos, M. H.; Ray, J. H.; Troubetzkoy, E. S. (United Nuclear Corp., White Plains, N. Y. Development Div.). Dec. 31, 1964. Contract DA-18-108-AMC-131(A). 292p. (AD–616629).

Neutron cross-section sets were prepared for 16 elements or isotopes for neutron energies from 0.037 eV to 18 MeV. The cross sections tabulated include the total, elastic, inelastic, (n,2n) and fission cross sections, as well as cross sections for charged-particle emission. Information is also given on the angular distribution of elastically scattered neutrons and on the energy distribution of neutrons and γ rays following nonelastic scattering. (auth)

27580 THE DECAY BY CAPTURE ^{153}Gd → ^{153}Eu. Boyer, P.; Chedin, P.; Oms, J. (Univ., Grenoble, France. CEN, Grenoble, France). Nucl. Phys., A99: 213-27(1967). (In French).

The capture decay ^{153}Gd → ^{153}Eu was investigated by means of a double-focusing iron-free magnetic β spectrometer and an electrostatic β spectrometer equipped for electron-γ coincidences. The photon spectrum has been studied by external conversion, and the method is shown to be reliable even for x rays. The internal conversion spectrum agrees with a previous measurement. The relative intensities of photons Kα/69.7/97.4/103.2 are 346 ± 30/7.5 ± 0.7/100/70 ± 3, which shows a bigger proportion of X photons than values previously available. The 97.4-keV transition in ^{153}Eu is confirmed to be pure E1, and its internal conversion coefficient is $\alpha_{97}^{K} = 0.28 \pm 0.03$. K-capture and branching ratios of the main transitions are determined; the ground-state capture is found more important than previously reported. The deduced value of the decay energy is 237 ± 4 keV. (auth)

27581 STUDY OF THE ^{104g}Rh, ^{104m}Rh, ^{116m_1}In, AND ^{182m}Ta DECAYS WITH A LITHIUM-DRIFTED GERMANIUM DETECTOR. Fettweis, P.; Vervier, J. (CEN, Mol, Belg.). Z. Phys., 201: 465-89(1967).

The decay schemes of ^{104g}Rh (1^+, 42 sec), ^{104m}Rh (5^+, 4.4 min), ^{116m_1}In (5^+, 54 min) and ^{182m}Ta (16.3 min) were re-investigated using lithium-drifted germanium detectors. By differential activation the decay of ^{104g}Rh was studied independently of that of ^{104m}Rh, leading to revised decay schemes for both isomers. The existence of a very weak (1%) 0.355–0.465 MeV cascade between the 2^+, 0^+ and 2^+ levels of ^{116}Sn at 2.12, 1.75 and 1.29 MeV, respectively, in the ^{116m_1}In decay was confirmed, as well as the general features of the ^{182m}Ta decay. (auth)

27582 FISSION OF ^{197}Au BY 13.4 MeV DEUTERONS. Natanson, L. (Inst. of Nuclear Research, Warsaw); Decowski, P. Acta Phys. Pol., 31: 599-600(Mar. 1967).

The method of fragment detection in mica was used for the investigation of the reaction ^{197}Au(d,f) with 13.4 MeV deuterons. The number of fragments observed corresponded within experimental errors to the expected effect of U contamination of the Au sample which was tested in a separate experiment with reactor neutrons. The upper limit of the Au fission cross section is estimated as 10^{-34} cm^2. (auth)

27583 COLLECTIVE GYROMAGNETIC RATIO g_R OF ODD-ODD NUCLEI. MAGNETIC AND ELECTRICAL PROPERTIES OF ^{170}Tm. Balodis, M. K.; Peker, L. K.; Prokof'ev, P. T. (All-Union Scientific-Research Inst. of Metrology, Leningrad). Izv. Akad. Nauk SSSR, Ser. Fiz., 30: 1330-3(Aug. 1966). (In Russian).

It is shown that, owing to random circumstances, the gyromagnetic ratios g_R and g_K, conditioned by the collective movement of the nucleus and movement of unpaired nucleons, can also be determined for the configuration $p^{1/2+}$ [411]; $n^{1/2-}$ [521], corresponding to the fundamental state of ^{170}Tm with $I^{\pi} = K^{\pi} = 1^{-}$. In this case, $g_R \approx +0.247 \approx g_K$. It is further shown that from the experimental findings on the electric quadrupole moment Q(Q = +0.574 ± 0.009 barn) and relative intensities of γ 114 and γ 75 for ^{170}Tm, it is possible to estimate the effect of the cross-over matrix element of the operator of Q, which is found to be relatively small but sufficient to reduce the electric quadrupole moment Q by 10 to 20%. (JPRS)

27584 INVESTIGATION OF THE α SPECTRUM OF ^{225}Ac. Dzhelepov, B. S.; Ivanov, R. B.; Moskvin, L. N.; Rodionov, V. F. Izv. Akad. Nauk SSSR, Ser. Fiz., 30: 1322-4(Aug. 1966). (In Russian).

Revised values of the energies and intensities of the α-transitions of ^{225}Ac are presented. The source itself was obtained by bombarding a thorium target with protons of 660-MeV energy in a synchrocyclotron. The α-spectrum was investigated by means of a magnetic α spectrometer. In addition to the already known α groups, a number of new low-intensity transitions was detected and tabulated. To verify that they belong in the ^{225}Ac group, the spectral regions in which they are present were subjected to another exposure in order to determine the corresponding half-life periods. In general, these findings are in satisfactory agreement with the data of KALEVI VALLI (Ann. Acad. Sci. Fenn., Ser. A VI, Physica: 165 (1964)). (JPRS)

27585 MULTIPOLE ORDER OF THE 1095-keV TRANSITION IN ^{172}Yb. Balalaev, V. A.; Dzhelepov, B. S.; Medvedev, A. I.; Uchevatkin, I. F.; Shestopalova, S. A. (All-Union Scientific-Research Inst. of Metrology, Leningrad). Izv. Akad. Nauk SSSR, Ser. Fiz., 30: 1314-21(Aug. 1966). (In Russian).

STAUTBERG et al. (Phys. Rev., 130: 1901 (1963)) claim that the multipole order of the transition with 1095-keV energy in ^{172}Yb is M1 + 5% E2, whereas GUENTHER et al. (Nucl. Phys., 61: 65 (1965)) conclude that it is M1 + 5%M3 + (<0.2% E2); both these findings diametrically contradict the authors' earlier findings (DZHELEPOV et al., Izv. AN SSSR, Ser. Fiz., 28: 64 (1964)) that the multipole order of this transition is either E + 2 (5)% M1 or E1 + (15 ± 1)% M2. To clarify this matter, a new method of investigation was adopted: a ^{171}Lu + ^{172}Lu preparation was employed, since one of the transitions occurring in ^{171}Yb during the decay of ^{171}Lu has a known multipole order (with reference to the 740-keV transition). The results obtained were found to be in virtual agreement with the earlier findings of the authors: $\alpha_{K1095} = 2.5 \pm 0.4 \times 10^{-3}$. It is not yet clear why STAUTBERG et al. and GUENTHER et al. drew other conclusions from their measurements of angular correlation, but there can not be any doubt as to the quantity α_{K1095}. (JPRS)

27586 γ-RAY SPECTRUM OF ^{143}Ce. Arutyunyan, E. A.; Vrzal, Ya.; Dzhelepov, B. S.; Liptak, Ya.; Urbanets, Ya.; Khol'nov, Yu. V. Izv. Akad. Nauk SSSR, Ser. Fiz., 30: 1253-9(Aug. 1966). (In Russian).

The γ radiation of ^{143}Ce was investigated with the aid of a Ge(Li) spectrometer. Detector characteristics: depth of sensitive layer, ~6mm; working volume, ~5 cm^3; half-width of the γ-lines of ^{60}Co, ~4 keV. The source was prepared by the (n,γ) reaction of a specimen of ^{142}Ce enriched to 89.7%. The γ spectrum was measured over the energy range of up to 2000 keV with the aid of 512- and 2048-channel pulse analyzers, the average exposure time being three hours. The values obtained for the energies and relative intensities of the γ rays of ^{143}Ce are tabulated. Twenty-six γ lines were obtained. The findings are generally in agreement with the findings of other investigators. Major difference in intensities are observed for the transitions with energies of 372, 587, 795 (triple line), and 936 keV, however. The transitions E γ = 392, 500, 556, 804, 1000, 1029, 1044, 1058, 1325 keV do not fit in the scheme of ^{143}Pr proposed by Gopinathan et al. (Phys. Rev., 136: 1247 (1964)) (measurements with scintillation spectrometers). (JPRS)

27587 LIFETIMES OF THE LOWER EXCITED STATES OF ^{189}Ir. Kryukova, L. N.; Kordyukevich, V. O.; Sorokin, A. A. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz., 30: 1360-3(Aug. 1966). (In Russian).

To verify the assumption that the lower excited states of ^{189}Ir may be regarded as levels of a deformed nucleus which represent a system of two rotational bands based on single-particle Nilsson states $3/2^{+}$[402] and $1/2^{+}$[400], the lifetimes of the first and second excited levels of ^{189}Ir (with energies of 94 and 113 keV) were measured. The source used was a Pt fraction chemically isolated from a proton-irradiated Au target. The lifetimes were measured by means of a β-γ coincidence spectrometer. Pulses from the photomultiplier anodes were transmitted to a time-amplitude converter. For the 94-keV level, it was found that $T^{\gamma}_{1/2}$ (M1) = 3.1×10^{-7} sec and $T^{\gamma}_{1/2}$ (E2) = 1×10^{-7} sec. For the 113-keV level, it was found that $T^{\gamma}_{1/2}$ (M1) $\leq 1.36 \times 10^{-9}$ sec and $T^{\gamma}_{1/2}$ (E2) $\leq 9.6 \times 10^{-9}$ sec. These findings strengthen the theory that the 94-keV level is chiefly a single-particle (proton) level and the 113-keV level is the second rotational term of the fundamental rotational band with k = 3/2. (JPRS)

27588 $\beta + \gamma$ COINCIDENCES DURING THE DECAY OF $^{152}Tb \rightarrow {}^{152}Gd$. Dzhelepov, B. S.; Kraft, O. E.; Naumov, Yu. V. Izv. Akad. Nauk SSSR, Ser. Fiz., 30: 1286-91(Aug. 1966). (In Russian).

The coincidences were measured with the object of procuring more information on the spin of the ^{152}Tb nucleus, which has not previously been experimentally determined. A magnetic β-γ coincidence spectrometer was used. The magnetic spectrometer isolated positrons within a specified energy range, and the γ spectrometer recorded the γ radiation coinciding with these positrons. The measurements pertained to the spectrum of γ rays coinciding with positrons of the following energies: ~2500, ~2000, ~1500, and ~1200 keV. With a decrease in positron energies, coincidences with γ 272 quanta are observed. The fundamental state of ^{152}Tb can not have the characteristic $I^{\pi} \geq 3^{\pm}$. The most probable values of the spin and parity of the fundamental state of ^{152}Tb must be regarded as 1^{-}. (JPRS)

27589 γ-RAY SPECTRUM OF ^{147}Nd. Arutyunyan, E. A.; Vrzal, Ya.; Dzhelepov, B. S.; Liptak, Ya.; Urbanets, Ya.; Khol'nov, Yu. V. Izv. Akad. Nauk SSSR, Ser. Fiz., 30: 1260-4(Aug. 1966). (In Russian).

The γ-ray spectrum of ^{147}Nd was investigated with the aid of a Ge(Li) detector built in the Prague Institute of Solid-State Physics. The spectrum was recorded by means of 2048- and 512-channel pulse analyzers. The ^{147}Nd source was obtained from enriched ^{146}Nd with the aid of the reaction $^{146}Nd(n,\gamma)^{147}Nd$. Four series of measurements with an average exposure time of ~3 hr were carried out. The intensities of all γ lines decrease in time with a period equal to the half life of ^{147}Nd. The recorded intensities and energies of the γ rays of ^{147}Nd were tabulated and were compared with the E_{γ} and I_{γ} obtained by means of a magnetic γ spectrometer, a scintillation spectrometer, and a β spectrometer of the $\pi\sqrt{2}$ type. Peaks corresponding to the γ transitions at 542, 590, 610, and 622 keV could be plotted for the first time. The presence of 310-keV γ rays corresponding to the transition 720 → 410 keV, which was observed by Gunye et al. (Saraf. Phys. Rev., 124: 172 (1961)), could not be confirmed (the intensity of the corresponding quanta was below 0.2 of the intensity of the transition E_{γ} = 531 keV). (JPRS)

27590 γ-SPECTRUM OF ^{154}Eu. Dzhelepov, B. S.; Dmitriev, A. G.; Zhukovskii, N. N.; Maloyan, A. G. Izv. Akad. Nauk SSSR, Ser. Fiz., 30: 1265-76(Aug. 1966). (In Russian).

γ radiation of ^{154}Eu was investigated with the aid of a magnetic spectrometer. All the isolated γ lines of ^{154}Eu and their relative intensities were tabulated. Altogether, 32 γ lines were detected in the region $h\nu > 200$ keV, of which only 14 lines had been previously known. The conversion coefficients for transitions to ^{154}Gd can be determined by utilizing the data on the relative intensities of the K-conversion and γ lines accompanying the decay of ^{154}Eu on condition that the conversion coefficient of at least one transition is known. The scheme of ^{154}Gd levels is complemented with two new levels with the energies 1617 and 1663 keV. The first level is deexcited by three transitions $h\nu$ = 1493, 1248, and 616 keV to the levels 2^{+}, 2^{+}, and 4^{+} with the energies 123, 371, and 998 keV, respectively. The level with 1663-keV energy makes it possible to place the observed γ transitions having energies of 1539, 847, and 616 keV; they are arrayed between this level and the levels 2^{+}, 2^{+}, and 4^{+} with the energies of 123, 816, and 1049 keV, respectively. The balance of intensities of γ transitions with respect to ^{154}Gd levels was utilized to determine the percentile ratio of the β components of ^{154}Eu and to calculate the values of log ft, which are found to be anomalously high. (JPRS)

27591 ON THE THEORY OF NUCLEAR STRUCTURE EFFECT ON INTERNAL CONVERSION IN ^{203}Tl. Rapoport, L. P.; Chekanova, S. S. Ivz. Vyssh. Ucheb. Zaved., Fiz., No. 1, 22-5 (1967). (In Russian).

The Fermi-liquid theory was used to evaluate the influence of strong interaction on the penetrating matrix element of the ^{203}Tl conversion transition. The theoretical results obtained are in good agreement with experimental data. (tr-auth)

27592 ISOTOPIC ENRICHMENT AND THERMAL NEUTRON CROSS SECTION MEASUREMENT OF ^{167}Er. Su, C. S.; White, F. A. (Rensselaer Polytechnic Inst., Troy, N. Y.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci., NS-14: No. 2, 1-6(Apr. 1967).

The thermal neutron cross section of ^{167}Er was obtained by measuring the relative number of ^{168}Er atoms formed by radiative neutron capture, when isotopically pure ^{167}Er samples were exposed to a highly-thermalized neutron flux. A four-stage mass spectrometer was used to provide a $10^6/1$ isotopic enrichment of ^{167}Er. It was also employed to measure the post-irradiation ^{168}Er/^{167}Er isotopic ratios of the samples, which were placed in the D_2O-moderated Argonne CP-5 reactor. The integrated neutron flux, and effective neutron temperature in this reactor were also monitored mass spectrometrically, by observing isotopic ratio changes in nuclides whose cross sections as a function of temperature are known. Two rare-earth isotopes ^{149}Sm and ^{157}Gd were selected as the "non-1/v" absorbers that yielded this data. The effective neutron cross section of ^{167}Er was found to be 740 ± 21 barns, at an effective neutron temperature of 42.8 ± 2.5°C, with an integrated neutron flux of $3.37 \pm 0.08 \times 10^{19}$ neutron/cm^2. The thermal (2200 m/sec) neutron cross section of ^{167}Er was then calculated to be 699 ± 20 barns. (auth)

27593 ELECTRON AND PHOTON EXCITATION OF NUCLEAR ISOMERS. **Booth, Edward C.; Brownson, John (Boston Univ.). Nucl. Phys., A98: 529-41(1967).**

Long-lived isomeric states in stable nuclei ^{87}Sr, ^{111}Cd, ^{113}In, ^{115}In, and ^{199}Hg were excited by photons and electrons at energies below 3 MeV. Excitation functions and absorption measurements gave new information on energy levels, transition probabilities and multipolarities of excited states which decay to the isomeric states. (auth)

27594 MULTIPOLARITIES OF PRIMARY γ RAYS IN ^{199}Hg(n,γ)^{200}Hg AND PARITIES OF LEVELS IN ^{200}Hg. Bartholomew, G. A.; Gunye, M. R.; Earle, E. D. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys., 45: 2063-78(June 1967). (AECL-2897).

Linear polarization correlation measurements show that the "anomalous intensity" region, $E_\gamma > 4.5$ MeV, of the spectrum of γ rays following thermal neutron capture in ^{199}Hg contains predominantly E1 γ rays and that levels at 1.57, 2.06, 2.37, 2.64, 3.19, 3.27, and 3.29 MeV in ^{200}Hg have positive parity. (auth)

27595 THE DECAY OF ^{147}Nd. **Hill, John C.; Wiedenbeck, M. L. (Univ. of Michigan, Ann Arbor). Nucl. Phys., A98: 599-613(1967).**

Precision energy measurements on 8 gamma rays in the ^{147}Nd → ^{147}Pm decay were made with a 2m curved-crystal spectrometer. Energies of the 6 other gamma rays were determined with a Ge(Li) spectrometer. The relative intensities of all gamma rays were determined. A level scheme is proposed for ^{147}Pm which includes a new level at 680.4 keV. Evidence is given to support the exclusion of several levels reported by earlier investigators. Results are compared with predictions of intermediate coupling theory. (auth)

27596 EXPERIMENTAL TESTS OF RECENT PAIRING-PLUS-QUADRUPOLE MODEL CALCULATIONS IN THE OSMIUM NUCLEI. **Casten, R. F.; Greenberg, J. S.; Burginyon, G. A.; Bromley, D. A. (Yale Univ., New Haven). Phys. Rev. Lett., 18: 912-15(May 22, 1967).**

A comparison of the predicted E2 transition rates with new experimental results is reported. This comparison is particularly sensitive to the detailed structure of the calculated wave functions. The discussion is confined presently to states with spins of 4 or less for which there exist calculated values. Transition probabilities and branching ratios for ^{186}Os, ^{188}Os, ^{190}Os, and ^{192}Os were obtained by Coulomb excitation induced by ^{16}O ions with incident laboratory energies of 48.3, 62.1, and 70.3 MeV. Gamma spectra and B(E2) values are given. (J.F.P.)

27597 SHORT-LIVED FISSION PRODUCTS. **Fritze, K.; Griffiths, K. (McMaster Univ., Hamilton, Ont.). Radiochim. Acta, 7: 59-60(Mar. 1967).**

A search for new fission products of ^{235}U was made. Proof of the presence of a given nuclide depended on the identification of a known daughter activity resulting from the decay of the unknown short-lived parent, which was separated completely from daughter activities as soon as possible after the end of the irradiation. The decay chains of masses 79, 109, 118, 119, and 125 were considered. The procedures used and results obtained in the search for ^{79}Ge, ^{109}Ru, ^{118}Ag, ^{119}Ag, and ^{125}In are given. (D.H.M.)

27598 FURTHER STUDY ON γ TRANSITIONS IN ^{140}Ce. El-Nesr, M. S.; El-Aassar, M. R. (Atomic Energy Establishment, Cairo). Z. Naturforsch., 22A: 299-308(Mar. 1967).

A photoline spectrum from the γ rays of energies greater than 200 keV following the decay of 40-hour ^{140}La was studied using a high-resolution double-focusing β spectrometer. The photoelectrons are produced from a uranium radiator of thickness 2.9 mg/cm^2. The resulting momentum resolution was 0.3 → 0.8% depending on energy. In addition to γ rays previously reported, previously unreported γ transitions were observed in the energy region of about one MeV to 2.53 MeV. The relative γ-ray intensities were determined from the external conversion spectrum applying the corrections for the angular dependence of the photo-electric process. Gamma energies and intensities higher than 2.53 MeV were investigated by means of a scintillation spectrometer using a RIDL-transistorized 400-channel analyzer. A complete set of energy sums was computed in order to survey the possibilities of cascade crossover combinations. Thirteen direct ground-state transitions of energies 204.87, 241.95, 993.12, 1597.48, 1973.38, 2026.37, 2350.23, 2371.11, 2410.33, 2530.03, 2900, 3100, and 3471 keV were observed. A few modifications on the previously reported level scheme of ^{140}Ce are proposed after the addition of the 17 new γ rays. Conversion coefficients were obtained by normalizing the ratios of conversion and photon intensities with respect to the 487-keV, E2 transition in ^{140}Ce. From the known internal conversion coefficient of this transition, the absolute K-internal conversion coefficients of the transitions 200.08, 241.95, 273.69, 337.50, 374.81, 400.53 and 875.30 keV were determined to confirm their multipolarities and to support spin and parity assignments of the levels 242, 617, 1260, 1323, 2184, 2515, 2585 and 3390 keV. The absolute K-internal conversion coefficients of the 542.43, 641.41, 752.62, 927.41, 980.19, 1016.20, 1040.31 and 1054.65 keV transitions were measured for the first time. The multipolarity assignments of these transitions were studied on the basis of the conversion coefficients. These measurements together with the previously known assigned levels establish the spins and parities 3−, 0+, 2+, 4+, 2+, and 2+ for the levels 205, 1889, 1973, 2084, 2350 and 2530 keV, respectively. Spin and parity assignments of 1+ and 4− are proposed for the 2900 and 3100 keV excited levels in ^{140}Ce, respectively. (auth)

27599 K-CONVERSION COEFFICIENTS OF TRANSITIONS IN ^{114}In AND ^{114}Cd. **El-Nesr, M. S.; Awwad, Z.; El-Aassar, M. R. (Atomic Energy Establishment, Cairo). Z. Naturforsch., 22A: 309-16(Mar. 1967).**

The K-conversion coefficients of the 192-keV isomeric transition in ^{114}In and the 556- and 722-keV transitions in ^{114}Cd were measured for the first time by means of a high-resolution double-focusing β spectrometer, using the internal-external conversion method. The data confirm the essentially pure E4 character of the 5+ → 1+, 192-keV transition in ^{114}In and the pure E2 character of the 4+ → 2+, 722-keV and 2+ → 0+, 556-keV transitions in ^{114}Cd. The conversion coefficient measurements reported in ^{114}Cd and ^{114}In (Z = 48 and 49) and in earlier studies (Z = 22 – 28 and 56) indicate that E2-conversion coefficients in the Z region below 60 are in good agreement with theory. (auth)

27600 LOW ENERGETIC EXCITATIONS OF ODD NONAXIAL NUCLEI. **Kashuba, I. E. (Inst. of Physics, Kiev). Ukr. Fiz. Zh., 12: 546-53(Apr. 1967). (In Russian).**

Detailed theoretical investigations of atomic nuclei ^{165}Ho, ^{165}Dy, ^{167}Er, ^{175}Lu, ^{177}Lu, ^{177}Hf, ^{181}Ta, ^{245}Cm, ^{249}Bk with the spin in the main state 7/2 are considered. The investigations were based on the model developed in the works of A. S. Davydov where unadiabateness of collective movements in the relation to single particle ones was taken into account. The calculated values of the spins and the excitation energies are in good agreement with the experimental values. (auth)

27601 DELAYED ELECTRIC DIPOLAR TRANSITION IN ^{183}Ta. **Berthier, Jean; Nobar, Youssef Motavalledi; Blachot, Jean (Faculte des Sciences, Grenoble, France). Compt. Rend., Ser. B, 264: 258-61(Jan. 16, 1967). (In French).**

The lifetime of the 73-keV level of ^{183}Hf was measured by the delayed coincidence method and with a time-amplitude converter. A value of $T_{1/2}$ = 107 ± 11 nsec was obtained. The order of magnitude of the coefficient α_K deduced from the spectra in coincidence with the 783-keV γ ray indicates that the 73-keV transition is a delayed E1 transition between the levels $\frac{9}{2}^-$ [514] and $\frac{7}{2}^+$ [404]. (tr-auth)

27602 INTERNAL CONVERSION COEFFICIENTS OF THE 25.6- AND 84.1-keV TRANSITIONS OF THE DECAY ^{231}Th → ^{231}Pa. Barat, Jean-Louis; Boyer, Pierre; Henck, Roland; Gizon, Andree; Pelletier, Anne-Marie (Faculte des Sciences, Grenoble, France. Centre de Recherches Nucleaires, Strasbourg). Compt. Rend., Ser. B, 264: 262-5(Jan. 16, 1967). (In French).

Measurements of the relative intensity of internal conversion electrons, relative γ intensities, and e-γ coincidences made it possible to obtain the values $\alpha_{L25.6} = 2.3 \pm 0.1$, $\alpha_{25.6} = 3.2 \pm 0.2$, $\alpha_{L84.1} = 1.36 \pm 0.18$, and $\alpha_{84.1} = 1.83 \pm 0.25$. (tr-auth)

27603 THORIUM FISSION CROSS-SECTION FOR NEUTRONS BETWEEN 12.5 AND 18 MeV USING FISSION FRAGMENT DAMAGE TRACKS IN LEXAN. **Rago, P. F.; Goldstein, N. (Naval Radiological Defense Lab., San Francisco). Health Phys., 13: 654-6(June 1967).**

Materials such as mica, plastics, and glass may be used as neutron detectors when placed next to a fission foil. The fission foil-detector method for determining neutron fluxes, and its application to the measurement of thorium fission cross section for neutrons between 12.5 and 18 MeV, are described. It is pointed out that such a detection system is useful for measuring 14-MeV neutron fluxes around low-voltage generators, where competing reactions can make analysis of activation foil data difficult. The material employed was Lexan polycarbonate resin. Although the cross section of ^{232}Th could be determined directly from the sensitivity factor, a more direct approach was employed, by utilizing available cross section data for ^{238}U and exposing Th–Lexan and U–Lexan pairs simultaneously to monoenergetic neutrons. The measured Th fission cross section was then the ratio of the ^{232}Th and ^{238}U fission fragment tracks per unit area multiplied by the ^{238}U cross section. Within experimental error the values obtained agree with recent values obtained by other workers. (UK)

27604 ELASTIC AND INELASTIC SCATTERING OF 14-MeV PROTONS FROM ^{111}Cd, ^{112}Cd, AND ^{113}Cd. **Koike, Masahiro (Tokyo Univ.). Nucl. Phys., A98: 209-27(1967).**

Elastic and inelastic scattering of protons from ^{111}Cd, ^{112}Cd, and ^{113}Cd were studied using the 14.2 to 14.7 MeV proton beam extracted from the INS cyclotron. The analysis of the emitted particles was made with a broad-range magnetic spectrometer. The particles were detected with a 250-channel, solid-state detector array placed along the focal plane of the spectrometer. The over-all energy resolution was about 0.2%. The angular distributions for the elastic and inelastic scattering were measured. Optical-model parameters were adjusted to reproduce the angular distributions for the elastic scattering. The analysis based on the distorted-wave Born approximation (DWBA) was made for the inelastic scattering. The first-order collective excitation was assumed for the interaction. Effective deformabilities β_l were extracted from the analysis. (auth)

27605 SPECTRUM SHAPE MEASUREMENT OF TWO BETA TRANSITIONS IN ^{111}Ag. **Lehmann, J. (CEN, Mol, Belg.). Nucl. Phys., A98: 273-7(1967).**

The spectrum shape factors of the 685 and 1028-keV beta transitions in the decay of ^{111}Ag were measured. The experimental results are compared with the predictions of the extreme single-particle shell model. (auth)

27606 THE DECAY OF ^{191}Au AND THE LEVEL SCHEME OF ^{191}Pt. **Johansson, A.; Nyman, B.; Malmsten, G.; Karlsson, S.-E. (Uppsala Univ.). Nucl. Phys., A98: 278-304(1967).**

A total of 84 transitions in ^{191}Pt were established by studying the internal conversion spectrum following the decay of ^{191}Au with high-resolution, magnetic, beta spectrometers. Multipolarities and mixing ratios for the strongest transitions were deduced from K/L ratios and/or L subshell ratios. The high accuracy of the transition energy determinations together with calculated total transition intensities, established multipolarities, and information from coincidence experiments enabled the construction of a consistent level scheme comprising 25 excited levels and 69 transitions. This level scheme deviates greatly from that proposed by Marklund et al. (auth)

27607 ISOMER SHIFTS OF gamma RAYS IN ^{151}Eu AND ^{153}Eu. **Steichele, Erich (Technische Hochschule, Darmstadt, Ger.). Z. Phys., 201: 331-49(1967). (In German).**

Isomer shifts of the 21.7-keV γ line of ^{151}Eu and of the 97-keV and 103-keV γ lines of ^{153}Eu were measured by Mössbauer techniques in various di- and trivalent Eu compounds. It is found that the ratio of the isomer shifts for two lines and the same absorber combination is independent of the absorbers. (auth)

27608 g-FACTOR MEASUREMENT BY THE METHOD OF DIFFERENTIAL PERTURBED ANGULAR CORRELATION. **Kardon, Bela; Kiss, Dezso; Perjes, Zoltan; Seres, Zoltan; Zamori, Zoltan. KFKI (Kozp. Fiz. Kut. Int.) Kozlem., 15: 63-83(1967). (In Hungarian).**

The method of differential perturbed angular correlation measurement is described, presenting in detail, as an example, the g-factor measurement carried out on ^{181}Ta. A description of the experimental setup and the statistical evaluation procedure is given together with the complete computer program written in ALGOL. (auth)

27609 MEASUREMENT OF THE RELATIVE PROBABILITY OF TERNARY FISSION IN ^{233}U, ^{235}U, ^{238}U, AND ^{232}Th. **Nagy, Laszlo; Nagy, Tibor; Vinnay, Istvan. KFKI (Kozp. Fiz. Kut. Int.) Kozlem., 15: 85-93(1967). (In Hungarian).**

Using the double ionization chamber technique, the probability of long-range α-particle emission was determined from measurements on the fission of ^{233}U, ^{235}U, ^{238}U, and ^{232}Th induced by slow, 2.5-MeV, and 14-MeV neutrons. (auth)

27610 HIGH-ENERGY CONVERSION ELECTRONS OF ^{114}Cd FOLLOWING NEUTRON CAPTURE. **von Egidy, T.; Kaiser, W. (Technische Hochschule, Munich). Z. Phys., 201: 378-93(1967). (In German).**

Internal-conversion electrons of ^{114}Cd following neutron capture in ^{113}Cd were measured using a magnetic beta spectrometer in the energy range between 1350 and 9100 keV. 132 conversion lines of 115 transitions were found. The multipolarities of most of these transitions were determined. The known level scheme of ^{114}Cd was extended. An additional level at 1863.3 keV was disclosed. Spins and parities were assigned for 19 states. (auth)

27611 MEASUREMENT OF THE NUCLEAR GAMMA RAY IN MUONIC ^{152}Sm. **Bernow, S.; Devons, S.; Duerdoth, I.; Hitlin, D.; Kast, J. W.; Macagno, E. R.; Rainwater, J.; Runge, K.; Wu, C. S. (Columbia Univ., New York). Phys. Rev. Lett., 18: 787-91(May 8, 1967).**

The energy of the first rotational nuclear gamma ray of ^{152}Sm in the presence of a muon in a 1s state was found to be 1.03 ± 0.15 keV greater than the normal transition energy. This type of measurement provides a method of determining the change in mean square radius between ground and excited states (isomer shift) in deformed nuclei. (auth)

27612 MAGNETIC AND QUADRUPOLE-MOMENT RATIOS OF THE FIRST-EXCITED STATES IN ^{186}W AND ^{182}W. **Persson, B.; Blumberg, H.; Agresti, D. (California Inst. of Tech., Pasadena). Contract AT(04-3)-63. Phys. Lett., 24B: 522-4 (May 15, 1967).**

The following ratios of moments in ^{186}W and ^{182}W were measured in Mössbauer transmission experiments: $^{186}\mu(2^+)/^{182}\mu(2^+) = 1.16 \pm 0.02$, $^{186}Q_{22}/^{182}Q_{22} = 0.86 \pm 0.01$. A comparison with the corresponding ratio of the transition moments, $^{186}Q_{02}/^{182}Q_{02} = 0.94 \pm 0.03$, shows a disagreement with the simple rotational model. (auth)

27613 ISOMER SHIFT IN ^{152}Sm. **Steiner, P. (Univ., Hamburg); Gerdau, E.; Kienle, P.; Koerner, H. J. Phys. Lett., 24B: 515-17(May 15, 1967).**

An isomer shift of $6.66 \pm 0.25 \times 10^{-7}$ eV was observed for the 122-keV $2^+ \rightarrow 0^+$ transition in ^{152}Sm between Sm^{3+} and Sm^{2+} compounds. A value of $\Delta\langle r^2\rangle = 19 \times 10^{-3}$ fm^2 is deduced which is compared with theories of rotation excitation. (auth)

27614 MEAN PRIMARY CHARGE OF LIGHT FRAGMENTS FROM THERMAL NEUTRON FISSION OF ^{235}U. **Reisdorf, W. (Technische Hochschule, Munich); Armbruster, P. Phys. Lett., 24B: 501-3(May 15, 1967).**

The variation of nuclear charge with mass in the thermal neutron fission of ^{235}U was investigated by simultaneous measurement of the masses and characteristic K ray energies associated with the primary fission fragments. (auth)

27615 SPECTROSCOPY OF ^{206}Pb BY INELASTIC SCATTERING OF 24.5 MeV PROTONS. **Vallois, G.; Saudinos, J.; Beer, O. (Centre d'Etudes Nucleaires, Saclay, France). Phys. Lett., 24B: 512-14(May 15, 1967).**

Inelastic proton scattering by ^{206}Pb shows a 2^+, 4^+, 6^+, 8^+ collective level sequence with intensities and energies of excitation of the same order as in ^{208}Pb and in ^{207}Pb. The 3.776-MeV level, which is strongly excited, was determined to be 5^-. (auth)

27616 THE MAXIMUM DOPPLER EFFECT. **Keane, A.; Horner, T. S. (Wollongong University Coll., New South Wales). J. Nucl. Sci. Technol. (Tokyo), 4: 149-51(Mar. 1967).**

The maximum numerical values of the Doppler coefficient of a single Breit–Wigner resonance and the dilutions for which the stationary values occur were found as a function of temperature. The results are tabulated in terms of parameters which are independent of the particular resonance and model. (auth)

27617 ENERGY SPECTRA OF CHARGED PARTICLES ACCOMPANYING FISSION OF W BY PROTONS WITH $E_p = 660$ MeV. Bychenkov, V. S.; Perfilov, N. A. Yadern. Fiz., 5: 727-33(Apr. 1967). (In Russian).

Energy spectra of α particles and protons emitted at fission and spallation of W nuclei with 660-MeV protons are studied. By adding in proper proportion the spectrum of vaporized particles from the moving half-nucleus to that of the particles from the W spallation one succeeded in constructing the spectrum coinciding up to the errors with the spectrum of particles from the fission. It is found that 57% of all α particles and 77% of all protons from the fission, cascade particles included, are emitted from excited fragments. The conclusion follows that at the fission of W by 660-MeV protons the ratio $\Gamma_j/\Gamma_{n,p,\alpha}$ decreases with the particles evaporation. (auth)

27618 THE MEASUREMENT OF THE ICC OF THE 192-keV TRANSITION IN /sup 114m/In. **Rao, M. Raja; Jnanananda, Swami (Andhra Univ., Waltair, India). Indian J. Phys., 41: 55-9(Jan. 1967).**

A method employing the internal-external-conversion technique using a well-type plastic scintillation spectrometer (Raja Rao and Jnanananda, 1965) was adapted for the measurement of the internal conversion coefficient for the 192 keV transition in ^{114m}In with foils of Ta and Cd as external converters. The average value obtained for the deduced $\alpha_k = 1.95 \pm 0.29$ which is compared with the theoretical values of Rose and Sliv. (auth)

27619 GAMMA–GAMMA DIRECTIONAL CORRELATIONS IN ^{144}Pr. Gupta, S. L.; Saha, N. K. (Univ. of Delhi). Indian J. Phys., 41: 48-54(Jan. 1967).

The gamma rays of energy range 34 to 100 keV, following the beta decay of ^{144}Ce, were studied using coincidence and directional correlation methods, taking into account the highly disturbing scattering effects in this region. The correlation function found for the 54 to 80 keV cascade supports the spin assignment of 0^- for the ^{144}Pr ground state. It is further shown that the direct angular correlation measurement of the 34 to 100 keV cascade cannot lead to any unambiguous spin assignment of the ground state. (auth)

27620 γ-γ DIRECTIONAL CORRELATION STUDIES AND LEVEL SCHEME OF ^{134}Ba. Rama Mohan, R. V.; Reddy, K. Venkata; Raju, B. B. Venkatapathi; Jnanananda, Swami (Andhra Univ., Waltair, India). Indian J. Phys., 41: 30-8(Jan. 1967).

The decay scheme of ^{134}Cs was studied and the $\gamma-\gamma$ angular correlation measurement carried out for the cascades 605-797 keV (separated), 1368-605 keV, 963-605 keV, 565-605 keV, 800-1168 keV, and 432-797 keV. On the basis of experimental data on directional correlations, spin assignments are made for 605, 1168, 1402, 1568, 1645, 1834 and 1973 keV excited levels. Multipole assignments are also made for the 1368, 1040, and 963 keV transitions. (auth)

27621 OBSERVATION OF CENTRIFUGAL STRETCHING IN ^{152}Sm. Yeboah-Amankwah, D.; Grodzins, L.; Frankel, Richard B. (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-2098. Phys. Rev. Lett., 18: 791-4(May 8, 1967). (MIT–2098-306).

An isomer shift has been observed in the Mössbauer study of the 121.8-keV ($2^+ \rightarrow 0^+$) transition in ^{152}Sm. A value of $(\Delta\langle R^2\rangle/\langle R^2\rangle)_{2-0} = (10 \pm 3) \times 10^{-4}$ is deduced, based on isotope shift data for ^{152}Sm and ^{154}Sm. This value disagrees with present theoretical prediction. In particular, the influence of the β band in ^{152}Sm can only account for about 20% of the observed stretching. (auth)

Nuclear Theory

Refer also to abstracts 26066, 26973, 27010, 27321, 27340, 27393, 27441, 27450, 27524, 27530, and 27554.

27622 (JINR–P4-3204) OPISANIE VRASHCHENIYA YADER METODOM KOLLEKTIVNOI PEREMENNOI. (Description of the Nuclear Rotational Band by the Collective Variable Method). Nadzhakov, E.; Mikhailov, I. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1967. 10p. (In Russian). Dep.

The method of a collective variable canonically conjugated to the angular momentum operator is generalized to describe the energy spacings between all the states of the rotational band. Formulas giving the energy dependence on the angular momentum are obtained for a quantum–mechanical model of an even–even nucleus rotating in a plane. These formulas generalize the Inglis' formula for the moment of inertia. (auth)

27623 (ORNL-TM-1831) A FORTRAN PROGRAM FOR ELASTIC DEUTERON SCATTERING. Robson, B. A. (Oak Ridge National Lab., Tenn.). Apr. 19, 1967. Contract W-7405-eng-26. 43p. Dep. CFSTI.

A FORTRAN program was written to calculate the elastic scattering of deuterons by complex nuclei. The scattering is described by an optical-model potential which includes some tensor forces. (auth)

27624 INTERACTION POTENTIALS OF THE LIGHT NUCLEI AT LARGE DISTANCES. Pipiraite, P. P.; Shugurov, V. K. (Vilnyus State Univ., USSR). Lietuvos Fiz. Rinkinys, Lietuvos TSR Mokslu Akad., Lietuvos TSR Aukstosios Mokyklos, 6: 507-12(1966). (In Russian).

Supposing that the interaction between two nucleons is of the Yukawa type multiplied by scalar products of spins or isospins, the potentials of the interaction between the lightest nuclei are found. The dependence on spin orientation is also determined. (auth)

27625 STATISTICAL THEORY OF NUCLEAR CROSS SECTION FLUCTUATIONS. Krieger, Theodore J. (Brookhaven National Lab., Upton, N. Y.). Contract AT(30-2)-Gen-16. Ann. Phys. (N. Y.), 42: 375-402(May 1967). (BNL–10301).

The method of "random matrices," employed originally in the study of energy level distributions of complex systems, is applied to the analysis of nuclear cross section averages and fluctuations in the continuum region. A generalization of the "orthogonal" ensemble of random unitary symmetric matrices introduced by Dyson is postulated as the underlying statistical ensemble of collision matrices from which averages and variances of nuclear reaction cross sections may be calculated. Analytical results are obtained only in the asymptotic limit $N \gg 1$, where N is the number of open channels, i.e., the dimension of the matrices considered. Effects due to energy resolution of the measuring apparatus and to "direct" or fast processes as well as to slow processes such as compound nucleus formation are considered. The method has the advantage of yielding results that are invariant with respect to a transformation of channel-representation, e.g., from channel-spin s to projectile momentum j. Consistency with unitarity is achieved by treating the collision matrix as the basic random variable rather than one or more of its matrix elements. The discussion is limited to angle-integrated cross sections corresponding to given values of spin and parity, but the extension to the more general case is straightforward. (auth)

27626 PAULI PRINCIPLE IN THE CENTER-OF-MASS SYSTEM. Aviles, Joseph B. Jr. (Naval Research Lab., Washington, D. C.). Ann. Phys. (N. Y.), 42: 403-44(May 1967).

The internal states of motion of an arbitrary closed system are studied in terms of a set of $3N-3$ pairs of internal canonical variables. The complexities involved in constructing states which satisfy the Pauli principle are reduced by expressing these states in terms of ν sets of internal variables which are associated with the ν ways in which one of ν identical particles may be eliminated. A formalism is set up whereby a simplified expression for the scalar product (and hence matrix elements) is obtained. For purposes of illustration the method is applied to systems of N spinless bosons and fermions interacting through oscillator forces and constrained to move in one dimension. For N identical particles it is shown that the internal Hamiltonian assumes an independent "particle" form only for a system of oscillators. In a section concerned with internal operators, several useful properties of the internal motion of an arbitrary closed system are discussed. (auth)

27627 PAIRING EFFECTS IN NUCLEI DESCRIBED BY THE HARTREE–FOCK THEORY. Pal, M. K.; Stamp, A. P. (Massachusetts Inst. of Tech., Cambridge). Nucl. Phys., A99: 228-40 (1967).

The amount of energy gap between occupied and unoccupied single-particle states determines the reliability of a Hartree-Fock (HF) calculation. If the gap is comparable to the residual pairing interaction, the sharp Fermi surface corresponding to the HF state is smeared out through mixing with pair-excited configurations. In heavy and medium-heavy nuclei it is believed that such mixing with configurations having several pairs is important. In the light 2s 1d shell nuclei, where the energy gap is 6 to 8 MeV, it is a fairly good approximation to calculate the correction to the HF state by mixing only the two hole (h)-two particle (p) type excited configurations. Such corrections represent a genuine pairing correlation present in the intrinsic state. Formulas were worked out for diagonalizing the residual interaction between the HF state and the 2h-2p states. Explicit numerical results are presented for ^{20}Ne using the two-body, effective matrix elements of the Yale potential. The corrected ground state is found to contain about 8% admixture of excited configurations, thus showing that the pairing corrections are not very important in 2s 1d shell nuclei. The reason for this finding is analyzed. (auth)

27628 THE STRUCTURE OF THE sd-SHELL NUCLEI. III. EFFECT OF NONCENTRAL INTERACTIONS. Inoue, T. (Nihon Univ., Tokyo); Sebe, T.; Huang, K. K.; Arima, A. Nucl. Phys., A99: 305-20(1967).

The effects of noncentral interactions on ^{18}O, ^{18}F, ^{19}O, and ^{19}F are studied by the shell model. These effects are not important in ^{18}O and ^{19}F; but the level structures of ^{18}F and ^{19}O are found to be affected by these noncentral interactions. The possibility of the core excitation is also pointed out. The levels at 1.08 MeV and 2.10 MeV and the 1^+ level at 1.7 MeV in ^{18}F belong possibly to the core-excited states. Phenomenological matrix elements found are compared with the reaction matrices derived from the Hamada-Johnston potential. (auth)

27629 PROTON–PROTON PHASE SHIFTS AT 50 MeV. Perring, J. K. (Atomic Energy Research Establishment, Harwell, Eng.). Nucl. Phys., A99: 241-5(1967).

The p-p scattering data near 50 MeV, including a recent accurate set of cross-section measurements, are analyzed in terms of phase shifts. Only the S-, P-, and D-phases are found to differ significantly from the one-pion-exchange values. The results are more accurate than those obtained previously and are more consistent with results at other energies. (auth)

27630 SIGNS OF NUCLEAR QUADRUPOLE MOMENTS. Sharon, Yitzhak Y. (Princeton Univ., N. J.). Nucl. Phys., A99: 321-36(1967).

The experimental data on the signs of all the measured quadrupole moments in the ground states of nuclei are analyzed. Positive quadrupole moments are found in virtually all the cases where the last major proton and neutron shells are both more than one-fifth full. For odd-mass nuclei the quadrupole moment is negative (positive) when the odd nucleons occupy $^1/_8$ or less ($^7/_8$ or more) of the last major shell. The last observation is shown to be an extension of the known rules for the signs of the quadrupole moments of odd-mass nuclei with one particle outside (or missing from) a closed shell. (auth)

27631 THEORY OF (p,p') AND (p,n) REACTIONS THROUGH THE ISOBARIC ANALOGUE RESONANCES. I. ISOSPIN PURITY OF THE DOORWAY FUNCTION IN THE INTERNAL REGION. Weidenmueller, Hans A. (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-2098. Nucl. Phys., A99: 269-88(1967). (MIT-2098-305).

Results known for the case of a single open proton channel from the analysis of Lane's model are extended to the case of several open proton channels using a particle-hole description of the isobaric analogue state. This description is equivalent to Lane's model in the one open channel case. External and internal Coulomb mixing are discussed. It is shown that, in the case of two open proton channels, the wave function at resonance has three types of Coulomb admixtures in the internal region—one due to internal mixing and one due to external mixing, both of which are the same for all channels. The amplitudes of both these admixtures display a Breit–Wigner resonance. The third admixture depends on the incident channel. Aside from displaying a resonance behavior, this amplitude vanishes at a (real) energy $E_>$ slightly above resonance. In the case when several proton channels are open, this offers a basis for explaining the asymmetries observed in (p,n) total cross sections and sometimes in (p,p') cross sections. Ambiguities in the generalization of Lane's model to inelastic proton scattering are discussed. (auth)

27632 THEORY OF (p,p') AND (p,n) REACTIONS THROUGH THE ISOBARIC ANALOGUE RESONANCES. II. CALCULATION OF ELASTIC AND INELASTIC CROSS SECTIONS. Weidenmueller, Hans A. (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-2098. Nucl. Phys., A99: 289-304(1967). (MIT-2098-303).

Using previous results on the isospin purity of the doorway part of the proton scattering wave functions in the internal region, a statistical model is used for the complicated compound nuclear resonances to derive formulas for the energy-averaged S-matrix elements describing inelastic proton scattering and for the transmission coefficients. These expressions, together with the Hauser-Feshbach theory of nuclear reactions, provide a frame for the analysis of experimental data. The analysis suggested in this paper makes use of an optical-model description of the elastic background scattering cross section in each channel and aims at extracting the partial widths of the analog resonance from the data. These widths are proportional to the spectroscopic factors. The influence of direct inelastic proton scattering upon the results is discussed. The relation between the results and those found previously for the case of one open proton channel is established. The energy averaged S-matrix elements are sums of two terms, the first describing the purely elastic optical-model background. The second term has the form of a Breit-Wigner formula. The total width in this formula is given by the sum over all channels of the partial widths of the analogue resonance plus a spreading width. The latter contains terms arising both from internal and external mixing. The partial widths in the Breit-Wigner formula are proportional to the partial widths of the analogue resonance. The proportionality factors are channel-dependent and complex and contain the influence of optical-model corrections. The transmission coefficients are each sums of two terms. One has the usual form one obtains from a one-level approximation to the scattering matrix. It displays a Breit-Wigner resonance. The other term contains the asymmetry characteristic of the analogue resonances. Compared with the case of one open proton channel, this asymmetry is smoothed out both because of internal mixing and because several proton channels are open. (auth)

27633 DIFFRACTION PARTICLE SCATTERING BY ATOMIC NUCLEI. Inopin, E. V. (Physical-Technical Inst., Kiev). Izv. Akad. Nauk SSSR, Ser. Fiz., 30: 1238-47(Aug. 1966). (In Russian).

A brief review is given on published data on diffraction scattering. Elastic and inelastic diffraction scattering, diffraction scattering and direct nuclear reactions, and high-energy physics are discussed. A strong similarity between direct nuclear processes with participation of strongly absorbing nuclei and elementary particle collisions at energies of several GeV is stressed. It is shown that the strong absorption is a result of intense inelastic processes and that strong interactions characterized by an interaction radius are taking place in both cases. 39 references. (R.V.J.)

27634 MAGNITUDE OF FUNCTIONS DETERMINING THE PROBABILITY OF β^+ DECAY. I. ALLOWED TRANSITIONS. Suslov, Yu. P. Izv. Akad. Nauk SSSR, Ser. Fiz., 30: 1248-52 (Aug. 1966). (In Russian).

An attempt was made to obtain functions for determining the influence of atomic fields on the β-decay probability, simultaneously accounting for finite nuclear dimensions and screening effects. A self-consistent potential was used for describing atomic fields with consideration of the exchange according to the Slater method. Detailed calculations and the magnitudes of functions for determining allowed β^+ decay are included. (R.V.J.)

27635 BETA DECAY. PART I. Janouch, Frantisek; Vinduska, Milan (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Rez). Cesk. Cas. Fys., 17: 287-302(1967). (In Czech).

A survey is given of the present state of the theory of beta radioactivity. The various approximations used in the theory of beta nuclear decay are discussed, and an analysis is made of the experiments by means of which the form of the decay Hamiltonian and the constants contained in it were determined. (auth)

27636 EFFECT OF POLARIZATION OF TARGET NUCLEI ON THE MAGNETIC SCATTERING OF NEUTRONS. Baryshevskii, V. G.; Korennaya, L. N. (Belorussian State Univ., Minsk). Dokl. Akad. Nauk BSSR, 10: 926-9(Dec. 1966). (In Russian).

It is assumed that a polarized beam of slow neutrons passes through a magnetized medium with polarized nuclei. An expression is written for the differential scattering cross section, and a solution is given in matrix form. It can be seen that if the polarization is different from zero, the interference between the magnetic and nuclear scattering does not vanish, even if the incident neutron beam is not polarized. The rotation of the neutron polarization vector takes place not only under magnetic and contruent nuclear scattering, but also as a result of interference of the magnetic and nuclear scattering. The neutron wave also possesses two refractory indices depending on the orientation of the neutron polarization vector with respect to the polarization of the nuclei. (TTT)

27637 DISTRIBUTION OF SPACINGS OF NUCLEAR ENERGY LEVELS OF MIXED SPIN AND PARITY. Huizenga, J. R.; Katsanos, A. A. (Argonne National Lab., Ill.). Nucl. Phys., A98: 614-24(1967).

An experimental spacing distribution for nuclear levels of mixed spin and parity is derived for 980 levels of 18 different nuclei. The experimental nuclear energy levels, taken from recent literature, were all determined by analyses of particles from (p,p') and/or (p,α) reactions with magnetic spectrographs. When proper account is taken of the experimental energy resolution, the spacing distribution is essentially exponential in character as expected for levels of both parities and mixed spin. (auth)

27638 REACTION MATRIX THEORY FOR FINITE NUCLEI. Koehler, H. S. (Rice Univ., Houston, Tex.). Nucl. Phys., A98: 569-76(1967). (ORO-1316-30).

A reaction matrix for calculations on finite nuclei is defined. It is shown that the single-particle energies in the propagator of the reaction matrix should be calculated self-consistently from the reaction matrix. With this definition, which in fact has been used in several previous publications, important terms in the Goldstone expansion are effectively summed, when one calculates the total energy to first order in the reaction matrix. This result is important if one e.g., calculates with harmonic oscillator wave functions. The remaining terms in the energy expansion are three-body terms and the single-particle excitation terms. The latter will cancel or be small only if a self-consistent single-particle potential is used. Some other higher-order terms are also discussed. The definition of the self-consistent or shell-model potential is briefly discussed. (auth)

27639 GAMOW–TELLER BETA DECAY IN HEAVY SPHERICAL NUCLEI AND THE UNLIKE PARTICLE-HOLE RPA. Halbleib, John A. Sr.; Sorensen, Raymond A. (Carnegie Inst. of Tech., Pittsburgh). Nucl. Phys., A98: 542-68(1967). (SC-DC-66-2376).

Allowed Gamow-Teller beta decay transition rates in medium and heavy spherical nuclei are calculated using the pairing-plus-quadrupole model with additional neutron-proton forces. Even-mass transition rates from the lowest $J^\pi = 1^+$ states of doubly odd nuclei to the ground and first excited states of the doubly even nuclei are calculated. The l-forbidden and non-l-forbidden odd-mass decays between the lowest states of given spins and parities are also computed. In addition to the pairing and quadrupole forces, neutrons and protons are allowed to interact through a zero-range force and a factorable long-range force specific to Gamow-Teller beta decay. The random phase approximation for the latter is developed and demonstrated. Generally, good agreement with experiment is obtained in the 2d region, but it becomes poorer as the theory is applied to lighter nuclei. (auth)

27640 THREE-NUCLEON CALCULATIONS WITH REALISTIC LOCAL POTENTIALS. Delves, L. M. (Univ. of Sussex, Falmer, Eng.); Blatt, J. M. Nucl. Phys., A98: 503-28(1967).

A series of variational calculations were made on the bound states of ^{3}H and of ^{3}He and on the doublet zero-energy scattering state in the presence of local potentials containing hard cores, and tensor and LS components. Results are given for the Hamada-Johnston, Gammel-Brueckner, and Yale potentials. (auth)

27641 AN APPROXIMATE CALCULATION OF MULTIPLE COULOMB EXCITATION. Brink, D. M.; Taylor, C. H. (Oxford Univ.). Nucl. Phys., A98: 460-72(1967).

An approximate method for solving the semi-classical equations of Coulomb excitation theory has been investigated. The exact time dependence of the projectile-target interaction was approximated by a rectangular pulse with strength and duration determined by comparison with perturbation theory and the sudden approximation. The pulse approximation gives a considerable improvement over the sudden approximation without increasing the numerical work appreciably. The accuracy of the approximation has been tested by making comparisons with exact numerical solutions of the semi-classical equations. (auth)

27642 STRUCTURE OF THREE-PARTICLE NUCLEI FROM PHOTODISINTEGRATION EXPERIMENTS. NUCLEAR AND COULOMB EFFECTS OF THE FINAL-STATE INTERACTION. Fetisov, V. N. (Lebedev Inst. of Physics, Moscow). Nucl. Phys., A98: 437-50(1967).

New experimental data on the γ-quantum absorption by the ^{3}He and ^{3}H nuclei are analyzed taking into account the nuclear and Coulomb interactions in the final state. The role of the asymptotic structure of the three-body wave functions in the photodisintegration theory is discussed. (auth)

27643 SUM RULE FOR THE MAGNETIC MOMENT OF ARBITRARY SPIN PARTICLE AND SIMPLE APPLICATION TO NUCLEUS. Konisi, Gaku (Kwansei Gakuin Univ., Nishinomiya, Japan); Yamamoto, Kunio. Progr. Theoret. Phys. (Kyoto), 37: 538-43(Mar. 1967).

A sum rule for the magnetic moment, formerly known to hold for particles with spins $^1\!/_2$, 1, and $^3\!/_2$ is shown to hold for arbitrary spin cases. The sum rule is examined in the cases of deuteron, ^{3}H and ^{3}He in order to see how this sum rule reflects the fact that the magnetic moment of nucleus can be calculated from those of the constituent nucleons and those of the orbital motions; it is shown that the sum rule reproduces the well-known approximate relations for their magnetic moments which were derived upon the fact that the nuclei are almost exclusively in the S state. (auth)

27644 APPROXIMATION FOR FORM FACTORS OF NUCLEAR STRIPPING AND PICK-UP REACTIONS. Kawai, Mitsuji; Yazaki, Koichi (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 37: 638-40(Mar. 1967).

A method of approximation for nuclear stripping and pickup reactions is proposed. This method may be useful when shell model wave functions are known for the nuclear wave functions. (J.F.P.)

27645 COUPLED CHANNEL METHOD FOR DIRECT REACTIONS. Bencze, Gy. (Univ. of Helsinki). Progr. Theoret. Phys. (Kyoto), 37: 202-4(Jan. 1967).

It is shown that the application of the formalism for the projection operators for the unified reaction theory of Feshbach together with the multidimensional generalization of the wave functions and corresponding wave equations to direct reactions processes leads to a straightforward generalization of the coupled channel calculation for elastic and inelastic scattering. The deuteron–nucleus collision process is considered, and it is assumed that the N(d,d′) and M(d,p) channels are coupled together. (J.F.P.)

27646 POLARIZATION PHENOMENA IN DIFFRACTION INTERACTION OF ^{6}Li WITH NUCLEI. Tartakovskii, V. K.; Ismatov, E. (Inst. of Physics, Kiev. Kiev State Univ.). Ukr. Fiz. Zh., 12: 529-34(Apr. 1967). (In Russian).

The diffraction interaction of ^{6}Li nuclei, considered in accordance with the Klaster model, with block nuclei, taking into account spin-orbit interaction of the particles with the target nuclei was studied. Distribution by angles was obtained, as well as polarization and quadrupolarization of scattered ^{6}Li nuclei and deuterons resulting from lithium splitting. The maximum value of the polarization of elastically scattered ^{6}Li nuclei is 0.2, quadrupolarization does not exceed 0.03. Polarization of the deuterons arising at an escape angle of $Q_d = 45.5°$ assumes a maximum value, equal to 0.23, while maximum quadrupolarization of deuterons with the same angle is approximately 0.1. (auth)

27647 ACCURATE RESONANCE PROFILES. Cook, James L. (Australian Atomic Energy Commission, Sutherland, New South Wales). J. Nucl. Sci. Technol. (Tokyo), 4: 47-50(Feb. 1967). (AAEC-TM-298).

An expression for the Doppler-broadened neutron resonance profile is derived, without the aid of the conventional approximation scheme. The area under this profile is examined and found to be weakly dependent upon temperature. (auth)

27648 COMPUTATION OF DOPPLER-BROADENED FUNCTIONS. Takano, Hideki (Japan Atomic Energy Research Inst., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 4: 154-5(Mar. 1967).

A refined technique is described for calculating Doppler-broadened functions, $\psi(\Theta,x)$, for neutron resonances. The proposed technique avoids the use of conventional central-difference equations which have been found to be very unstable and not sufficiently reliable. The method described is particularly convenient for computing the function $J(\Theta,\beta) = \int_0^\infty [\psi/(\psi + \beta)]dx$, and also seems well suited for computation of $\psi(\Theta,x)$ tables. (S.F.L.)

27649 POLARIZED WAVE FUNCTIONS FOR A FEW-BODY MODEL NUCLEUS. Aranoff, Sanford (Rutgers Univ., Newark, N. J.); Percus, Jerome K. Nucl. Phys., A98: 263-72(1967).

An approximation scheme for the wave function of a few-body system is developed, in which intrinsic polarization is introduced in a natural way. The polarized wave function is tested with model three- and four-body nuclei, and it is found that two different polarizations are nearly degenerate. The resulting resonant wave function yields accurate binding energies. Furthermore, the accuracy of the spatial density is checked by means of an error-estimating principle. The result is that the advantages of simplicity and generality of the polarized wave function are coupled with very good simulation of the correct wave function. (auth)

27650 ELASTIC SCATTERING OF NUCLEONS BY LIGHT NUCLEI. Tatischeff, B. (Institut de Physique Nucleaire, Orsay, France). Nucl. Phys., A98: 384-402(1967). (In French).

The cross section and polarization of nucleons of intermediate energies (100 to 300 MeV) elastically scattered by ^{4}He and ^{12}C were calculated within the impulse approximation including multiple scattering terms. The method is valuable for small angles. Several results are presented, which show good agreement, without any adjustable parameter. (auth)

27651 ENERGY LEVEL SPECTRA OF NUCLEI IN THE FISSION PROCESS. Cherdantsev, P. A.; Marshalkin, V. E. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz., No. 3, 155-61(1966). (In Russian).

Various stages of deformation in a nuclear fission process were analyzed. In the adiabatic approximation, these deformations have corresponding definite independent single-particle energy-level spectra. An attempt was made of finding the individual nucleon states in the nuclear fission process at certain postulations on the mechanism of the fission process. Nucleon single-particle states at large ellipsoidal nuclear deformations and nucleon single-particle states with a special potential of various frequency oscillations were analyzed. (R.V.J.)

27652 PARITY MIXING FOR ONE NUCLEON STATES IN LIGHT NUCLEI. Amiet, J.-P. (Univ., Heidelberg); Ebenhoeh, W.; Huguenin, P. Helv. Phys. Acta, 40: 283-92(1967). (In German).

The assumption of parity-mixing in single-nucleon orbitals is used in the case of mirror nuclei to derive a relation between magnetic moments and super-allowed β transitions. Various isospin dependences of the mixing are studied, one of which leads to the Winther formula. This last possibility clearly gives the best agreement with the neutron value $G_{GT}^2/G_F^2 = 1.55$ in the B-x diagram. (auth)

27653 CALCULATION OF DIFFRACTION SCATTERING CROSS SECTION IN AN ANALYTICAL FORM. Shebeko, A. V. Yadern. Fiz., 5: 766-70(Apr. 1967). (In Russian).

Using the method of complex angular momenta, an analytical expression is obtained for the cross section of the elastic diffraction scattering by nuclei in case when modulus of the scattering matrix $A(l) = [1 + \exp (l_0 - l)/\lambda]^{-1}$ and the phase shift $\delta_l = \delta_0[1 + \exp ((l - l_0)/\lambda)]^{-1}$. Provided the condition $|\delta_0| \le 1$ fulfills results of the calculations coincide with those of previous work. It is shown that at the condition $|\delta_0| \gg 1$, the scattering cross section decreases with the scattering angle ϑ as $\vartheta^{-1} \sin^{-1} \vartheta$ and oscillations of the cross section damp as the scattering angle increases. The Coulomb interaction is taken into account. (auth)

27654 EFFECT OF NUCLEAR DEFORMATION ON HYPERFINE STRUCTURE ANOMALY. Unna, I. (Hebrew Univ., Jerusalem). Phys. Lett., 24B: 499-500(May 15, 1967).

A recent measurement of the hyperfine structure anomaly of deformed ^{171}Yb and ^{173}Yb isotopes is interpreted in terms of the Nilsson model. It turns out that the anomaly is best reproduced with deformations which are consistent with those obtained by other, more direct, methods. (auth)

27655 NONLOCAL FACTORIZABLE POTENTIAL IN CALCULATIONS AFTER THE SHELL MODEL. Vashakidze, I. Sh. (Tbilisi State Univ., USSR). Yadern. Fiz., 5: 771-6(Apr. 1967). (In Russian).

It is shown how one can use nonlocal factorizable potentials in calculations after the shell model. Matrix elements of the particle-hole interaction are calculated. Corresponding calculations for the nucleus ^{16}O are carried out. (auth)

27656 VARIATION OF THE DENSITY MATRIX IN AN EXTERNAL FIELD FOR SUPERFLUID FERMI SYSTEMS AND GHOST-STATES IN THE THEORY OF NUCLEUS. Birbrair, B. L. (Ioffe Inst. of Physics and Tech., Leningrad). Yadern. Fiz., 5: 746-54(Apr. 1967). (In Russian).

It is shown that the Migdal-Larkin equations for the effective external fields V, V^h, d^1, d^2 in a superfluid Fermi system may be reduced to a system of equations for two quantities $\rho^{\pm} = \rho \pm \rho^h$ where ρ and ρ^h are variations of the particle and hole density matrices in the external field. Closed equations for ρ in fields of electric and magnetic types are obtained in the static limit. The results obtained are used to exclude the so called "ghost states" in the theory of the finite Fermi systems. (auth)

27657 MAGNETIC MOMENTS AND PION CURRENTS IN NUCLEAR MATTER. Nyman, E. M. (Stanford Univ., Calif.). Contract AF49(638)-1389. Nucl. Phys., B1: 535-50(1967).

The contribution from pion currents to the magnetic moment of a nucleon in nuclear matter is considered. It is shown that this effect is obtained by imposing gauge invariance on the charge-exchange part of the one-pion exchange potential. In the absence of correlations this mechanism is known to give a "quenching" of the moment. The change in the isovector part of the intrinsic magnetic moment is evaluated in a model which allows spin-dependent two-nucleon correlations as well as hard-core interactions. In the presence of correlations produced by the long-range tensor part of the one-pion exchange potential the moment is found to be enhanced by 0.26 nuclear magnetons. The present theory is incapable of predicting isoscalar contributions to the single-particle moments. (auth)

27658 THEORETICAL ANALYSIS OF KNOCK-OUT REACTIONS. Kolybasov, V. M.; Smorodinskaya, N. Ya. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz., 5: 777-85(Apr. 1967). (In Russian).

Differential cross sections of the (p,2p) reactions on light nuclei calculated in the pole approximation are compared with nearly all the experimental data available at energies 155, 185, and 450 MeV. The comparison of the proton widths of the light nuclei from the (p,2p) reactions and from stripping and pick-up reactions is carried out. In view of the consideration of the reactions (p,pn) and $(\pi^-,\pi^- n)$, the conditions are pointed out for the simple method of analysis based on the introduction of the conceptual effective number of nucleons in a nucleus to be applicable. (auth)

27659 TIME OF PARTICLE PENETRATING THROUGH BARRIER. Rybachenko, V. F. Yadern. Fiz., 5: 895-901(Apr. 1967). (In Russian).

The method given by Baz' to calculate a mean lifetime of intermediate states formed in nuclear reactions is used to calculate the mean time for the penetration of a particle through a potential barrier. A number of specific examples is considered for the one-dimensional motion and the solution of a three-dimensional problem analogous to the one-dimensional problem on the penetration of a particle through a barrier is given. (auth)

27660 EXCITATION OF TWO-PHONON STATES OF NUCLEUS BY DIFFRACTION SCATTERING. Drozdov, S. I. Yadern. Fiz., 5: 786-96(Apr. 1967). (In Russian).

The direct scattering of charged particles with the excitation of two-phonon vibrational or higher rotational states corresponding to the double angular momentum transfer is considered. The differential cross sections for the scattering at small angles are calculated in the diffraction and adiabatic approximations for a strongly absorptive (black) nucleus expanding the scattering amplitude up to the square terms on parameters indicating the deviation from the spherical form. Angular distributions at the inelastic scattering depend on the mode of the collective rotational or vibrational excitation. The interference between processes of single and double angular momentum exchanges results in the cross section dependence on the sign of the parameters mentioned. The effect of Coulomb excitation is essential at small scattering angles. (auth)

27661 MANY-BODY PROBLEM AND DIRECT NUCLEAR REACTIONS. VERTEX FUNCTIONS IN THREE-BODY PROBLEM. Blokhintsev, L. D.; Dolinskii, E. I. (Inst. of Nuclear Physics, Moscow). Yadern. Fiz., 5: 797-809(Apr. 1967). (In Russian).

The problem of the approximate calculation of the direct nuclear reactions amplitudes is discussed within the covariant formulation of nonrelativistic many-body problem. This problem reduces to the calculation of the simplest nonrelativistic Feynman graphs and vertex functions. Formulas for the vertex functions corresponding to three not identical zero-spin particles are obtained in terms of potential theory. These formulas describe the three-particle virtual decay of three-particle bound state as well as its decay into two-particle bound state and one particle. The obtained vertex functions differ from those used usually which are given by the overlap integral of the internal nuclear wave functions. In particular, they depend on a greater number of invariant variables. (auth)

27662 MANY-BODY DESCRIPTION OF NUCLEAR STRUCTURE AND REACTIONS. Course XXXVI of Proceedings of the International School of Physics "Enrico Fermi," Varenna, Italy, July 26-Aug. 14, 1965. Bloch, C. (ed.). New York, Academic Press, 1966. 607p. $26.50.

The basic concepts of the many-body theory are reviewed, and numerical results are discussed. Analytically soluble models are given, and the many-body theory of nuclear reactions is introduced. The systematic treatment of deformed nuclei from the many-body viewpoint, nuclear clustering, and the application of Landau's theory of Fermi liquids to nuclei are also covered. (D.C.W.)

REACTOR TECHNOLOGY

Central Power Reactors

Refer also to abstracts 26066, 26266, 26275, 26775, 26876, 26925, and 27564.

27663 (AD-634843) NEUTRON IMPORTANCE AND VARIATIONAL FORMULATION IN REACTOR PHYSICS. Nozawa, Reikichi (Uppsala Univ. (Sweden)). Feb. 25, 1966. Contract AF 61(052)-874. 48p. (ARL-66-0120). CFSTI $3.00 cy, $0.65 mn.

The neutron importance is studied as a physical concept for a time-dependent system considering the case where successive detections are made as well as the final detection. Successive detections make the importance equation inhomogeneous. Based on the physical interpretation of neutron importance, a new formulation of variational principles is proposed in a manner applicable to time-dependent systems. The proposed variational functionals are to be understood not as Lagrangian densities as in classical or quantum theory of fields but as total detection data in experiments. As an application, a method of Green's functions is developed to improve successively a trial flux. The modification factor for the source term in the diffusion equation is derived in a most elementary way. (auth)

27664 (AERE-R-5456) FUEL ELEMENTS AND IRRADIATION EQUIPMENT FOR RESEARCH REACTORS. Wood, W. F. (Atomic Energy Research Establishment, Harwell (England)). Apr. 1967. 58p. Dep. CFSTI. HMSO.

A summary of designs for fuel elements and neutron converters in materials testing reactors is given. Various irradiation facilities such as rigs and loops are discussed and designs are given. Fast flux irradiations in the Dounreay Fast Reactor are discussed. The design for a high-pressure water loop is presented and discussed. (M.L.S.)

27665 (BMI-1797) AN EVALUATION OF THE APPLICABILITY OF EXISTING DATA TO THE ANALYTICAL DESCRIPTION OF A NUCLEAR-REACTOR ACCIDENT. Quarterly Progress Report for January-March 1967. Morrison, David L.; Basham, Samuel J.; Blutreich, Joachim N.; (and others) (Battelle Memorial Inst., Columbus, Ohio). Apr. 1, 1967. Contract W-7405-eng-92. 56p. Dep. CFSTI.

Analysis of a loss-of-coolant accident in a 1000 MW(e) boiling water reactor was done by the use of NURLOC computer code. The results of these calculations were compared to other calculations of the LOFT accident. Thermal and transport properties of steam, hydrogen, and steam-hydrogen mixtures at elevated temperatures were evaluated for use in metal-water reaction analysis. A simple generalized fission-product-release model for a reactor was developed for use in estimating the fission-product release in loss-of-coolant accidents. Effect of numerous processes on the general character of fission-product release is evaluated; a rough estimate of the effect of heat-source depletion on core meltdown rates was obtained. Calculations of molecular iodine release from a pressure-vessel plenum chamber were extended to include examples of large BWR and PWR systems. (M.L.S.)

27666 (EUR-3116.n) KERNENERGIECENTRALE VAN 50 MWe TE DODEWAARD, JAARVERSLAG 1965. (50 MWe Dodewaard Nuclear Power Plant, Annual Report 1965). (Gemeenschappelijke Kernenergiecentrale Nederland N. V., Dodewaard. Samenwerkende Electriciteits-Productiebedrijven, N. V., Arnhem (Netherlands)). Sept. 1966. 72p. (In Dutch). Dep.

A general review of the current state of construction of the Dodewaard Nuclear Power Plant is given. Criteria for permissible radiation levels and a definition of nonaccessible areas during reactor operation are given; the amount of shielding required by this is then determined. A brief description of the containment system is employed; design and calculations for the pressure vessel are discussed. Installation of the turbines is discussed briefly. Safeguards employed in the inlet and exhaust control system are presented. A review of the preliminary experimental program is given. (M.L.S.)

27667 (GA-5808) ADVANCED BERYLLIUM OXIDE CONCEPTS. Progress Report for the Quarter Ending September 30, 1964. (General Dynamics Corp., San Diego, Calif. General Atomic Div.). Oct. 30, 1964. Contract AT(04-3)-187. 49p. Dep. CFSTI.

Efforts during the quarter were concentrated on specific problems related to the specifications for the first test module and its subsequent insertion into EBOR. The development of a suitably fueled BeO matrix also continued with particular emphasis on determining the type of samples to be incorporated in the next irradiation capsules. Cross section work and critical assembly analytical calculations were also done as preliminary checks on Pu isotope cross sections data prior to initiating a conceptual design study of a Pu-fueled EBOR core. An examination of some alternate cladding materials was undertaken. Information is included concerning Th utilization, Pu utilization, and EBOR test module development. (J.R.D.)

27668 (GA-5997) ADVANCED BERYLLIUM OXIDE CONCEPTS. Progress Report for the Quarter Ending December 31, 1964. (General Dynamics Corp., San Diego, Calif. General Atomic Div.). Jan. 22, 1965. Contract AT(04-3)-187. 60p. Dep. CFSTI.

The basic physics and engineering efforts toward the establishment of an expected performance of a plutonium-fueled Phoenix demonstration core in EBOR are presented. Two fuel element concepts are investigated; designs are presented. Some cross section evaluations are given. A determination of the migration of ^{6}Li in irradiated BeO bodies is made. Fabrication techniques for fueled BeO are discussed. Test data from the fuel elements are presented. (M.L.S.)

27669 (GA-6846) ABE-1: AN EXTERNALLY COOLED HIGH CONVERSION RATIO: ADVANCED BERYLLIA FUEL ELEMENT. Trickett, K. A.; Meyer, R. A.; McWhirter, A. D.; Malek, G. J. (General Dynamics Corp., San Diego, Calif. General Atomic Div.). Dec. 16, 1965. Contract AT(04-3)-187. 80p. Dep. CFSTI.

A design is given for an advanced beryllium fuel element. Fuel cycle costs and lifetime, considering annual partial reload, are evaluated. The principal uncertainties of the technical feasibility of the utility of such an element are detailed. (M.L.S.)

27670 (GA-7086) PUBLIC SERVICE COMPANY OF COLORADO 330-MW(E) HIGH-TEMPERATURE GAS-COOLED REACTOR RESEARCH AND DEVELOPMENT PROGRAM. Quarterly Progress Report for the Period Ending March 31, 1966. (General Dynamics Corp., San Diego, Calif. General Atomic Div.). May 11, 1966. Contract AT(04-3)-633. 116p. Dep. CFSTI.

Component development for the Fort St. Vrain Power Reactor is discussed. An analysis of the nuclear characteristics of the system is performed. Design and development of fuel materials is detailed. The fuel transfer machine design is given. Design and analysis of the series-steam-turbine driven circulator is presented. Work done on control drives is presented. The steam generator testing and design and coated particle development are discussed. (M.L.S.)

27671 (GA-7638) FLOW MODEL TESTS OF THE REACTOR OUTLET PLENUM FOR THE 330 MW(E) HTGR. Hausermann, R.; Malek, G. J.; Meyer, L. (General Dynamics Corp., San Diego, Calif. General Atomic Div.). Feb. 24, 1967. Contract AT(04-3)-633. 145p. Dep. CFSTI.

Tests of flow distribution and temperature mixing were conducted with air in a 0.28 scale model of the plenum between the core outlet and steam generator module inlets of an early design of the 330 MW(e) High-Temperature Gas-Cooled Reactor. The primary purpose of the tests was to determine the influence of plenum height on the flow imbalance among the steam generator modules and the temperature mixing in the plenum. Tests were made at a model Reynolds number of 0.5 times that of the prototype. Flow distribution to the steam generator modules was determined by measuring the flow rate in each steam generator module duct while providing nonuniform flow in the core region outlets. The flow imbalance in the steam generator module ducts was evaluated by comparing the results of each test case with the results for a reference case. Temperature mixing in the plenum was evaluated by injecting hot air into one or two of the core region outlets and measuring the residual temperature profile in the inlet of the steam generator module ducts. (auth)

27672 (GAMD-4583) THE REDUCTION OF NEUTRON LOSSES TO ^{236}U AND ^{237}Np IN REACTORS USING URANIUM RECYCLE BY FUEL SEGREGATION. Jaye, S. (General Dynamics Corp., San Diego, Calif. General Atomic Div.). Sept. 11, 1963. Contract AT(04-3)-167. 16p. Dep. CFSTI.

A method for the reduction of parasitic neutron absorption in ^{236}U and ^{237}Np in the HTGR is described. This is accomplished by segregating the recycled fuel from the enriched uranium feed. The methods of physical segregation of the fuel are discussed. Variations of mode of fuel recycle are also discussed. Fuel cycle characteristics and fuel segregation are tabulated. (M.L.S.)

27673 (GEAP-4939) SAFETY AND ECONOMIC CHARACTERISTICS OF A 1000 MWe FAST SODIUM-COOLED REACTOR DESIGN. Cohen, K. P.; O'Neill, G. L. (General Electric Co., Sunnyvale, Calif. Advanced Products Operation). Dec. 1965. Contract AT(04-3)-189. 170p. Dep. CFSTI.

A design for a 1000 MWe fast, Na-cooled, mixed oxide fueled reactor is presented based on an updated set of safety and design criteria. Primary emphasis has been placed on safety and assurance of technical feasibility. The criteria developed have implications in the areas of reactivity coefficients, core and fuel design, and primary system design. The economic performance of the reactor represents a distinctly conservative projection of the capability of this present concept. Only a limited amount of optimization has been carried out. Accident analyses have been performed in sufficient detail to determine the characteristic behavior of the plant in common accident situations, and to demonstrate that the design satisfies the safety criteria. Fuel costs have been calculated. Calculations of capital and operating costs have not been performed, except insofar as previous estimates for similar designs may be applicable. Some consideration has been given to the effects of uncertainties in the nuclear data and fuel performance on economics. (auth)

27674 (GEAP-5035) USE OF NEUTRON FILTERS FOR FAST REACTOR FUEL IRRADIATIONS IN A THERMAL REACTOR CORE. Wilkinson, L. E.; Morissette, R. P.; Field, J. H. (General Electric Co., San Jose, Calif. Nuclear Energy Div.). Aug. 1966. Contract AT(04-3)-189. 19p. Dep. CFSTI.

The use of filters is discussed for cases in which it is desirable to harden the spectrum of the incident neutrons on specimens of high cross section. It is shown that significant improvements can be made in the surface-to-center (and peak-to-average) power production ratios. This technique results in an improved temperature distribution in the fuel specimen that is more prototypical of the temperature profiles expected in the fast reactor fuels. A demonstration of this technique is discussed in which an 0.875-in. dia mixed oxide fuel containing 17% PuO_2 produced 18 kW/ft in a thermal reactor core after elimination of essentially all thermal neutrons. (auth)

27675 (GEAP-5097) DESIGN AND FABRICATION OF MARK IV SUPERHEAT FUEL FOR EVESR FUEL DEVELOPMENT PROGRAM. Hazel, V. E.; Ikeuye, D. T.; Lees, E. A.; Murdock, T. B.; Spalaris, C. N. (General Electric Co., Sunnyvale, Calif. Advanced Products Operation). Jan. 1967. Contract AT(04-3)-189. 133p. Dep. CFSTI.

The design and fabrication of the ESADA-VESR (EVESR) Mark IV fuel and fuel bundles are described. Mark IV fuel was designed to demonstrate the performance of superheat elements operating at high heat flux, high specific power, and high burnup typical of conditions desired in advanced steam-cooled reactors. One fuel element features turbulence promoters for improved heat transfer and another was spaced with projection spot-welded wires. Pellets and powder filled fuel rods were used. Alloys selected for fuel cladding were Inconel-625, Incoloy-800, and Hastelloy-X. (auth)

27676 (GEAP-5163) A PRELIMINARY EMPIRICAL APPROACH TO ESTIMATING REACTOR VESSEL DAMAGE RESULTING FROM A SEVERE NUCLEAR EXCURSION. Colmar, R. J. (General Electric Co., Sunnyvale, Calif. Advanced Products Operation). Jan. 1966. Contract AT(04-3)-189. 33p. Dep. CFSTI.

A preliminary formulation of a method used for evaluating potential vessel damage for liquid-moderated reactors following a severe nuclear excursion is discussed. In contrast, the TNT rationale, intrinsically a gas-liquid phenomenon, is shown to be grossly inappropriate as a reliable simulant of liquid-moderated reactors. Experimental evidence from liquid-vapor transient effects is used to evaluate certain empirical vessel-damage factors numerically. The principal factors evaluated are the fraction of the total energy release that is delivered to the vessel, f_c, and the energy-deposition-depth, H_{eff}. Contemporary data are utilized in a preliminary survey to evaluate these factors. The gross indications afforded by available data are that the mechanical energy that the pressure vessel absorbs is in the order of about 1 to 2% of the energy released to the environment and that the depth over which this energy is deposited is in the order of two vessel diameters provided the water depth over the core (or pressure source) exceeds this value. (auth)

27677 (GEAP-5262) BONUS ROD CLUSTER FUEL DESIGN STUDY. Final Report. Murdock, T. B. (comp.) (General Electric Co., Sunnyvale, Calif. Advanced Products Operation). Sept. 1966. Contract AT(04-3)-189. 101p. Dep. CFSTI.

The results of a design study to determine the feasibility of replacing the BONUS superheat core with a fuel rod cluster type are detailed. The general concepts examined are: fuel bundle mechanical design; thermal-hydraulic analysis of BONUS rod cluster fuel; nuclear analysis of fuel; fuel rod design; compatibility of rod cluster design with BONUS systems and procedures; and preliminary safeguards review. (M.L.S.)

27678 (GEAP-5276) DEVELOPMENT OF PULSED NEUTRON APPLICATION TO POWER REACTOR START-UP PROCEDURES. 17th Quarterly and Final Progress Report, April 1, 1966-July 31, 1966. Garelis, E.; Meyer, P. (General Electric Co., Pleasanton, Calif. Nuclear Technology Dept.). Nov. 1966. Contract AT(04-3)-189. 35p. Dep. CFSTI.

An investigation of the merits of using a pseudo random neutron source excitation to measure reactor impulse response functions is made. A theoretical and experimental study is examined. A study of the pulsed time behavior of a reflected slab reactor is presented using a simple one group symmetrically reflected diffusion theory model with delayed neutrons. A comparison of this model with a bare assembly shows the effect introduced by the inhomogeneity of a reflector. The analysis gives a comparison of the reactivity as determined from a static calculation with the reactivity as determined from dynamic measurements. Results of the pseudo random measurements are shown and discussed. (auth)

27679 (GEAP-5463) EVESR NUCLEAR SUPERHEAT FUEL DEVELOPMENT PROJECT. Nineteenth Quarterly Report, December 1966-February 1967. (General Electric Co., Sunnyvale, Calif. Advanced Products Operation). Mar. 1967. Contract AT(04-3)-189. 68p. Dep. CFSTI.

Developments in testing of superheat fuel rods are summarized. Burnup is calculated for both the annular rods and solid rod clusters. Fuel element failures are tabulated. The cladding materials and cladding thicknesses for both types of fuels are being examined. (M.L.S.)

27680 (IDO-17235) PRELIMINARY REACTOR PHYSICS CALCULATIONS FOR THE LOFT CORE NUCLEAR DESIGN. Scott, A. J. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Oct. 1965. Contract AT(10-1)-205. 65p. Dep. CFSTI.

The reactor physics calculational methods used for the stainless clad LOFT core are detailed. The preliminary design of the LOFT core summarizes a core description, calculational methods used, optimization of fuel enrichments, reactor control, power distribution, reactivity coefficients, and core lifetime. (M.L.S.)

27681 (IDO-17236) TURBO DEPLETION CALCULATIONS FOR LOFT. Scott, A. J. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). June 1966. Contract AT(10-1)-205. 56p. Dep. CFSTI.

Final design calculations for a Zircaloy clad LOFT core are presented. A description of the core and physical parameters is given; the TURBO model is presented. Fast group constants, thermal constants, and poison pin constants are calculated. Microscopic cross sections for TURBO are generated. Lumped fission product cross sections are calculated, as are xenon-hardened cross sections. (M.L.S.)

27682 (IFA-FR-52) VARIATIONAL METHODS IN NUCLEAR REACTOR THEORY. Rosescu, Teodor (Academia R. P. R., Bucharest. Institutul de Fizica Atomica). Sept. 1966. 28p. Dep.

A bibliography on the application of variational methods to reactor physics calculations is given. A list of 207 papers is presented with a descriptive comment on each paper. (M.L.S.)

27683 (IFA-FR-54) PERTURBATION THEORY IN REACTOR PHYSICS. Rosescu, Teodor (Academia R. P. R., Bucharest. Institutl de Fizica Atomica). Sept. 1966. 21p. Dep.

A bibliography of 147 papers are presented on perturbation theory in reactor theory. Availabilities are listed along with papers. (M.L.S.)

27684 (IITRI-578P21-28) STUDIES OF REACTOR CONTAINMENT. Progress Report Covering the Two Bimonthly Periods, December 1966-January 1967 and February-March 1967. Gallagher, E. V. (IIT Research Inst., Chicago, Ill.). Contract AT-(11-1)-578. 55p. (IITRI-T6042-28). Dep. CFSTI.

An analysis of effects of sudden decompression of water, which is applicable to reactor coolant compression, is given. An analysis of blowdown with flow-area changes is made. Experiments in the water shock tube are discussed. (M.L.S.)

27685 (JUL-422-RG) ENERGIEUEBERTRAGUNG BEIM MOSEL-REAKTOR. (Energy Transfer in the MOSEL Reactor). Heinrichs, H. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorentwicklung). Nov. 1966. 43p. (In German). Dep. mn.

A thermodynamic comparison of the various coolant proposals for a fused salt reactor is presented. The power density was considered with respect to the fuel salt quantity. Both of these represent a very important evaluation factor with respect to the selected coolant, although other factors such as current technology, technological problems, physical behavior, and cost questions must also be considered. The peculiarities to be expected in the individual coolants (mixtures of fluoride salts such as LiF, NaF, BeF_2, UF_4, and ThF_4) are indicated. For cooling a fused salt reactor of 2500 MW(t) output, a normal mantle (tube bundle system) was investigated for three different coolants and a direct contact heat exchanger for Pb; both systems are used internally and externally. In the first case a power density of about 65 to 110 MW/m^3 was obtained for the external heat exchanger and 60 to 600 MW/m^3 for the internal coolant, varying according to the tube diameter of the channel and current state (laminar or turbulent). For the case of the direct contact the power density is 300 to 900 MW/m^3 for the external and 500 to 1000 MW/m^3 for the internal heat exchanger. These numbers show significantly that it is desirable to investigate a direct contact heat exchange in order to study difficulties present. A steam generator necessary for additional energy transfer as integration of individual heat exchangers was analyzed to determine the attainable order of magnitudes absolutely and in comparison with other steam generators. The live steam state is 160 atm at 530°C; an intermediate superheating occurs at 530°C. Hot surface charge and power density with respect to the construction volume was calculated at 1.7×10^5 kcal/m^2 hr or 17.3 MW/m^3 in the preheater, 2.4×10^5 kcal/m^2 hr and 24.6 MW/m^3 in the evaporator, 0.18×10^5 kcal/m^2 hr and 8.1 MW/m^3 in the superheater, and 0.66×10^5 kcal/m^2 hr and 6.4 MW/m^3 in the intermediate superheater. For the steam generator as a total complex the hot surface charge is 1.1×10^5 kcal/m^2 hr and the power density is 11.2 MW/m^3. The hot surface charge of the 500 MW(e) THTR steam generator is between 1.29 and 1.5×10^5 kcal/m^2 hr according to the construction type. (tr-auth)

27686 (KFK-567) FUEL CYCLE ECONOMICS OF FAST BREEDERS WITH PLUTONIUM. Gupta, D.; Jansen, P. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). Feb. 1967. 21p. Dep.

An interdependence of reactor and fuel cycle costs is presented. Emphasis is placed on fuel cycle economics of fast breeders which use plutonium. Technical and cost data are tabulated for Na-cooled breeders using mixed oxide fuels and mixed carbide fuels. Costs are compared for other types of reactors. Cycle costs as a function of reactor parameters are also presented. (M.L.S.)

27687 (NAA-SR-Memo-4815) HNPF STEADY-STATE MODERATOR COOLING USING THE MARK A CONTROL ROD SCHEME. Imig, J. K. (Atomics International, Canoga Park, Calif.). Jan. 11, 1960. Contract AT(11-1)-Gen-8. 46p. Dep. CFSTI.

Outlet temperatures for the various flow paths are given as a function of total reactor Na flow that is supplied to the moderator coolant plenum. The effects of cross-flow between the various flow paths were neglected in the numerical calculations; however a qualitative evaluation of cross-flow effects is given. The dependence of heat transfer and nuclear characteristics on the process tube-moderator can scallop annulus as a function of thickness is given. The temperature difference along moderator can flats between the center of the flat and the beginning of the transition is given. The effects of separation of cladding from graphite are shown; normal temperatures that occur with complete contact of cladding and graphite are presented for comparison. (M.L.S.)

27688 (NAA-SR-Memo-7152(Rev.)) CONSIDERATIONS RELATING TO OPERATION OF THE SRE WITH A DAMAGED REFLECTOR ELEMENT. DeBear, W. S. (Atomics International, Canoga Park, Calif.). Mar. 13, 1962. Contract AT-(11-1)-Gen-8. 33p. Dep. CFSTI.

Information on possible effects on the Sodium Reactor Experiment (SRE) and its primary Na system which would be attributable to operation, at power, with a damaged reflector can in the core are discussed. Effects on nuclear and heat transfer characteristics, and material properties are considered, and calculations are presented as to the expected C input to the primary Na and removal capability of the hot trap. Experimental data indicative of beneficial performance from the cold trap are included, as are other observations on system cleanup since the admission of hydrocarbon to the primary Na. Information is provided on service life of the hot trap under several operating circumstances and on minimum C concentration which can be achieved with various values of C input. Techniques for early detection of future damage or changing system conditions are specified. It is concluded that existing Na purification equipment is adequate and that continued power operation of SRE with a damaged reflector can is feasible and technically sound. (auth)

27689 (NP-15908(Exh.D)(Vol.1)) BROOKWOOD NUCLEAR STATION UNIT NO. 1, PRELIMINARY FACILITY DESCRIPTION AND SAFETY ANALYSIS REPORT. Introduction and General Summary, Description of Site and Environment. (Rochester Gas and Electric Corp., N. Y.). [nd]. 82p. (DOCKET-50-244(Exh.D)(Vol.1)). Dep. CFSTI.

A general description of the Brookwood Nuclear Station is given. Brief discussions of the safety and siting are considered. Brief descriptions of the reactor and associated facilities are presented. (M.L.S.)

27690 (ORNL-TM-1718) DECONTAMINATION EXPERIENCE IN THE NUCLEAR SAFETY PILOT PLANT. Row, T. H. (Oak Ridge National Lab., Tenn.). Mar. 2, 1967. Contract W-7405-eng-26. 19p. Dep. CFSTI.

The Nuclear Safety Pilot Plant is a facility for studying the behavior in a containment system of fission products released from overheated fuel. Contamination of the main containment vessel during experiments has varied from molecular I_2 to mixed fission products and UO_2. A citrate solution proved effective in removal of UO_2, Ce, Ru and Ba-La. NaOH was used successfully in removing I_2 and Cs. (auth)

27691 (ORNL-TM-1800) STARTUP OF FAST REACTORS ON ^{235}U FUEL. Carlsmith, R. S.; Delene, J. G.; Jung, L. (Oak Ridge National Lab., Tenn.). May 1967. Contract W-7405-eng-26. 60p. Dep. CFSTI.

It is usually assumed that Pu for the initial inventory of fast breeders will be produced in thermal reactors. A possible alternative is the use of "fast converters," fueled with partially enriched U. We have studied the fuel cycles of several types of fast converters with regard to inventories, conversion ratios, fuel-cycle costs, and U ore utilization. The fast converter was found to have a performance potential considerably superior to that of the light-water-moderated thermal reactor, while the comparison with a heavy-water-moderated "advanced converter" depended on the design of the fast converter and on the economic assumptions that were made. (auth)

27692 (ORNL-TM-1822) CRITERIA FOR NOBLE-GAS REMOVAL USING PERMSELECTIVE MEMBRANES. Rainey, R. H. (Oak Ridge National Lab., Tenn.). Apr. 3, 1967. Contract W-7405-eng-26. 7p. Dep. CFSTI.

Criteria have been defined for experiments that are designed to develop a process for removing noble gases from a reactor containment shell under accident conditions. The effect of these criteria on the processing rate of the gas in the containment shell was calculated. When the characteristics of the permselective membranes to be used in this program have been determined, the processing rates will be used to establish equipment size and processing costs. The total cost will then be compared with the cost of the downtime of the reactor. (auth)

27693 (PG-Report-778) FIZDIZ: A FORTRAN IV COMPUTER PROGRAM FOR CALCULATING THE DIFFUSION OF RADIO-ACTIVE FISSION GASES FROM A HOLE IN A REACTOR FUEL ELEMENT. Brooks, H. R.; French, R. L. D. (United Kingdom Atomic Energy Authority, Sellafield (England). Production Group). 1967. 19p. Dep. CFSTI. HMSO 1s. 9d.

The IBM 7090 program described calculates the fission gas activity escape as a fraction of the activity released to the fuel/can interface for long-lived fission gases. The escape may be calculated for many combinations of hole dimensions, bar dimensions, fission gas diffusion coefficients, and radioactive decay constants. (UK)

27694 (TRG-Report-1355) A CRAM EDIT COMPILER FOR FEW-GROUP FLUX, POWER, AND BUCKLING MAPS FOR HERO AND CIVIL AGR's. Buckler, A. N. (United Kingdom Atomic Energy Authority, Sellafield (England). Reactor Group). Nov. 1966. 20p. Dep. CFSTI. UK 2s. 6d.

An edit compiler for the widely used 7090 CRAM code is described which gives form factors, channel flux power and buckling maps for both square and triangular pitched reactors. An experimental method of automating buckling recycle is also included. (UK)

27695 (WAPD-MRP-120) PRESSURIZED WATER REACTOR (PWR) PROJECT. Technical Progress Report for the Period January 21, 1967 to April 21, 1967. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Contract AT(11-1)-Gen-14. 90p. Dep. CFSTI.

A summary of the development and operation of the Shippingport pressurized water reactor project is given. Topics discussed are: PWR plant support including fluid systems and plant engineering, control engineering, plant analysis and testing, chemistry applications and plant materials; reactor mechanical design including the refuelling program of the PWR Core 1 and Core 2, PWR-2 Seed 2 reactor design and test, PWR-1 spent component examination program; PWR-2 thermal and hydraulic design; PWR nuclear analysis for operations; materials irradiation for fuel element development; PWR core engineering including enriched ceramic fuel process development, PWR Core 2 Seed 2 fuel elements and poison end supports, and PWR Core 2 Seed 2 fuel assemblies. (M.L.S.)

27696 (WAPD-TM-532(Add.1)) WIGL2 ADDENDUM 1: A PROGRAM FOR THE SOLUTION OF THE ONE-DIMENSIONAL, TWO-GROUP, SPACE-TIME DIFFUSION EQUATIONS ACCOUNTING FOR TEMPERATURE, XENON, AND CONTROL FEEDBACK. Henry, A. F.; Vota, A. V. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Jan. 1967. Contract AT(11-1)-Gen-14. 5p. Dep. CFSTI.

A description is given of the modifications to WIGL2, a one-dimensional, two-group, space-time diffusion theory program written in FORTRAN II and compiled on the Philco-2000. The program was converted to FORTRAN IV and compiled on the CDC-6600 with the changes described. (auth)

27697 (WCAP-3680-3) CONTROL OF XENON INSTABILITIES IN LARGE PWR'S. Quarterly Progress Report for the Period Ending March 31, 1967. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). Apr. 1967. Contract AT(30-1)-3680. 73p. (EURAEC-1830). Dep. CFSTI.

Work Performed under United States-Euratom Joint Research and Development Program.

A summary of work done on the control of xenon instability in pressurized water reactors is given. Results of calculations made to evaluate the sensitivity of stability characteristics to uncertainties in basic nuclear data are presented. A spatial stability analysis for a checker board fuel loading pattern is given. An evaluation of the tendency of a large core to undergo processing oscillations is presented. These calculations are performed for an 11 ft core with two perturbations located 90° apart on the principal axes. The effects of triple-peak steady-state power distributions on stability characteristics are evaluated. Local fuel temperature feedback effects caused by a flat power distribution are presented. (M.L.S.)

27698 KINETICS OF SODIUM-COOLED FAST REACTOR. An, Shigehiro (Tokyo Univ.). Nippon Genshiryoku Gakkaishi, 9: 202-11(Apr. 1967). (In Japanese).

The kinetics problems in reactivity coefficients, examples of experiment and analysis for a small fast reactor, theoretical analysis of stability and accidents in a large fast reactor, and kinetics of a modular fast reactor are described. (auth)

27699 SIMPLE METHOD FOR CONTROL ROD WORTH EVALUATION WITH DIFFUSION CODES. Nakamura, Shoichiro (Hitachi Ltd., Japan); Tsuchiya, Toyohiko; Wajima, J. Tsunetaka. J. Nucl. Sci. Technol. (Tokyo), 4: 159-63(Apr. 1967).

To present a simple method for calculating the worth of control rods in multiregion reactor cores, the well model approximation is applied to the finite difference diffusion code. The results of calculation are compared with experimental results obtained on the Ozenji Critical Facility, and also with calculations using transport equivalent constants. With its simplicity, the method proposed is accurate enough to suffice amply for most cases where only the reactivity is the end result sought, although the application of this method is limited to control rods inserted in the core region, and gives no information about the detailed neutron flux distribution around the control rod. (auth)

27700 BEHAVIOR OF SEVERAL RARE EARTH METAL OXIDE DISPERSIONS IN UO_2 AT HIGH TEMPERATURE. Kubota, Tadashi; Takahashi, Shuichiro (Mitsubishi Atomic Power Industries, Inc., Omiya, Japan). J. Nucl. Sci. Technol. (Tokyo), 4: 171-6(Apr. 1967).

Several rare earth metal oxide dispersions in $UO_2-Eu_2O_3$, Dy_2O_3 and Sm_2O_3 were subjected to steep temperature gradient at near melting temperature of UO_2 to investigate the compatibility of rare earth metal oxides with UO_2. Grains of massive form having a directional growth tendency were formed in the central region of the UO_2 containing the dispersions of rare earth metal oxides. No signs of columnar grain growth were observed, such as have been reported in UO_2 free of added elements. The original shapes of all three rare earth metal oxide particles were lost in the massive grain region. Various particular characteristics were observed in the microstructure of the different rare earth metal oxide$-UO_2$ systems. (auth)

27701 RESULTS OF THE SPECIAL TESTS CONDUCTED AT THE GARIGLIANO BWR POWER STATION UNDER THE RESEARCH AND DEVELOPMENT PROGRAM. Mirone, M. (Ente Nazionale per l'Energia Elettrica, Latina, Italy); Santasilia, F.; Colling, A. Energ. Nucl. (Milan), 14: 205-16(Apr. 1967).

Void tests for the Garigliano BWR are briefly described. Results of the tests are presented; comparisons with normal operating data are made. A brief description of the special equipment installed for the research program, with emphasis on the computer, is given. (M.L.S.)

27702 HISTORY OF THE NORSE-DUTCH COLLABORATION IN THE AREA OF ATOMIC ENERGY. Goedkoop, J. A. Atoomenergie Haar Toepass., 9: 47-56(Mar. 1967). (In Dutch).

The Norse-Dutch collaboration in the study and utilization of nuclear energy has lasted more than 15 years. The factors which led to this collaboration are described. The scientific studies made in this century in the Netherlands and Norway, which led to the realization that neither country is completely independent, were indicated. (J.S.R.)

27703 DEVELOPMENT OF FAST POWER BREEDERS. Fuchs, K.; Collatz, S.; Falkenberg, D.; Rockstroh, R. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie, 10: 69-78(Mar. 1967). (In German).

Trends of the development of Soviet nuclear energy and the international aspects of fast power breeders are discussed. The development programs for the fast power breeder in the U.S.S.R. are presented. (M.L.S.)

27704 TRENDS OF IMPORTANT NUCLEAR POWER PLANT PARAMETERS. Hulka, Ivan (Skoda Works, Plzen, Czech.). Jad. Energ., 13: 4-7(Jan. 1967). (In Czech).

The trends of parameters of pressurized water reactors, boiling water reactors, gas cooled graphite reactors, and heavy water reactors such as effective burnup, reactor output, net plant efficiency, steam and coolant temperature and pressure, capital costs, and power costs are discussed. (auth)

27705 SOME APPLICATIONS OF DYNAMIC MEASUREMENTS IN PRESSURIZED WATER REACTOR NUCLEAR POWER PLANTS. Rajagopal, V.; Gallagher, J. M. Jr. (Westinghouse Electric Corp., Pittsburgh). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci., NS-14: No. 2, 15-21(Apr. 1967).

Results of statistical correlation measurements for obtaining information in a complex system are presented. Experiments were performed on four nuclear power plants using conventional plant instrumentation. Inherent fluctuations, response to forced random, sinusoidal and step variations in reactivity were studied. Frequency domain analysis of the data was performed with a special purpose analog type analyzer for determining power and cross-power spectral densities. Results obtained demonstrate that significant semi-quantitative information on the process can be obtained from power spectral analysis on inherent fluctuations; and cross-power spectral techniques permit frequency response measurements and system parameter determination in commercial nuclear plants. (auth)

27706 RELEASE OF IODINE FROM URANIUM DIOXIDE FUEL. Allen, John (United Kingdom Atomic Energy Authority, Risley, Eng.). J. Brit. Nucl. Energy Soc., 6: 127-33(Apr. 1967).

^{131}I has been identified as the fission product of major importance in the safety and siting of UO_2 fuelled reactors. In any safety analysis, therefore, it is necessary to predict the quantity of I_2 released from failing fuel elements under the postulated fault and its subsequent release to atmosphere. Most of the work on the release of fission products from UO_2 has been directed towards the inert gases. Information on I_2 release from fuel is much more limited. The release of I_2 to atmosphere is complicated by the fact that I_2 can exist in at least three volatile forms and its mass transfer depends critically on the form. Work of interest in this connection is outlined, and it is shown how experimental data available might be used in reactor fault analysis. (auth)

27707 OPERATIONAL PROBLEMS IN NUCLEAR POWER STATIONS: CONFERENCE OF THE SWISS ASSOCIATION FOR ATOMIC ENERGY (SVA). Mackenthün, W. At. Strom, 13: 57-61(Apr. 1967). (In German).

The operations history of nuclear power stations is discussed. General characteristics of the presently operable power stations are presented. Economics of the various types of stations are discussed. (M.L.S.)

27708 FRENCH NUCLEAR PROGRAM IN THE LIGHT OF CHANGES MADE SINCE THE 2ND FORATOM CONGRESS. Huet, Pierre. Energ. Nucl. (Paris), 9: 64-7(Mar.-Apr. 1967). (In French).

Development of the French nuclear power program is presented. The effects of the rapidly advancing nuclear technology on the uranium market are considered. The importance of fast reactors for future use is emphasized. (M.L.S.)

27709 CONCERNING THE BREEDERS FOR FUTURE COURSE IN NUCLEAR ECONOMETRICA. Gibrat, R. Energ. Nucl. (Paris), 9: 90-100(Mar.-Apr. 1967). (In French).

Three problems touching breeders are considered as examples. The first is balanced economy, that is, systems comprising breeders and at the same time converters which makes a closed loop economy for production. The second examines the conditions of validity of numerical calculations often made, and in haste, on developing nuclear economies. The third problem is on the effect of size. Each problem is examined in detail. (auth)

27710 ENGINEERING OF FAST BREEDER REACTORS IN THE UNITED KINGDOM. Laithwaite, J. M. (United Kingdom Atomic Energy Authority, Risley, Eng.). Energ. Nucl. (Paris), 9: 101-7(Mar.-Apr. 1967).

The U. K. fast reactor programme indicating the design advances made following operation of the Dounreay Fast Reactor is reviewed. The factors considered in establishing the size and purpose of the Prototype Fast Reactor are briefly discussed. The problems of fuel design are briefly considered. A discussion of the main considerations affecting the plant design with reference to the major alternatives considered in working up to the present P. F. R. design is given. (auth)

27711 SWEDISH FAST REACTOR. Vestergaard, Robert. Energ. Nucl. (Paris), 9: 108-12(Mar.-Apr. 1967). (In French).

The author briefly discusses the progress made by Sweden in the field of reactors. He describes the FRO fast reactor which was put into service in February 1964, the experience obtained with this type of reactor, and its future. (auth)

27712 REACTIVITY CHANGES IN SALT-BOILING FAST REACTORS OF WARS AND SAWA TYPES. Taube, Mieczyslaw (Inst. of Nuclear Research, Warsaw). Nukleonika, 12: 231-4 (1967).

A specific effect of "bubbles dilution" in the fused chlorides in salt-boiling reactors is discussed and calculated. The mean volume-expansion coefficient is calculated for the heterogeneous boiling reactor WARS with Hg(met) as coolant and the homogeneous boiling reactor SAWA with $AlCl_3$ as coolant. A high critical stability is ensured by these calculations. (auth)

27713 LONG-TERM CHANGE OF BASIC PARAMETERS OF FAST REACTORS. Frankowski, Waclaw (Inst. of Nuclear Research, Swierk, Poland). Nukleonika, 12: 373-84(1967).

The analysis of the dynamic behaviour of large Pu bearing nuclear systems containing fast reactors involves the knowledge of three parameters: specific investment of Pu, breeding gain, and energy content of Pu fuel. These parameters taken for the system as a whole are time-dependent but under some conditions they can be calculated, using the known pattern of the long-term change of these parameters for a representative fast reactor. The present study reports the results of the theoretical investigation of this change for the principal types of fast reactors for various ways of fuel management and various initial core compositions. (auth)

27714 STUDY OF FLOW INSTABILITIES AND OF THEIR CONSEQUENCES ON THE SAFETY OF WATER REACTORS. Delchambre, Ph.; Millot, J. P. Bull. Inform. Sci. Tech. (Paris), No. 112, 71-86(Feb. 1967). (In French).

The power threshold for nucleate boiling and flow instability was measured in out-of-pile experiments performed in Grenoble as a function of the flow rate. The tests performed on CABRI, taking into account the coupling between void and power, shed light on the consequences of these phenomena for the whole core. We have measured for a given core and up to the instability threshold, the power variation as a function of the reactivity insertion necessary to obtain a given level, from critical point at zero power. In case of instability, we have investigated some instances of the behavior of power and of fuel plates temperatures after the beginning of the phenomenon. (auth)

27715 CALCULATION OF ACCIDENTS IN WATER REACTORS DURING OPERATION AT POWER. Blanc, H.; Dutraive, P.; Fabrega, S.; Millot, J. P. Bull. Inform. Sci. Tech. (Paris), No. 112, 87-94(Feb. 1967). (In French).

A computer code is detailed which will predict the behavior of a water-cooled reactor during an accident occurring when the reactor is being operated under normal conditions. Reactivity, loss-of-coolant, and power overshoot types of reactor accidents are discussed. (M.L.S.)

27716 EURATOM HANDBOOK FOR CALCULATING COSTS OF NUCLEAR POWER STATIONS. Frewer, Hans; Roehl, Fritz H. (Siemens-Schuckertwerke AG, Erlangen, Ger.). At. Strom, 13: 45-56(Apr. 1967). (In German).

A group of European firms worked out the principles of a standard method for cost calculations on nuclear power stations. The Euratom Handbook is a comprehensive two-volume report; extracts are given from the main chapters, comments being made from the point of view of German conditions. (auth)

27717 SIMULATION OF POWER BURSTS. Pascouet, A. Bull. Inform. Sci. Tech. (Paris), No. 112, 7-12(Feb. 1967). (In French).

The possible mechanical effects of nuclear power excursions in water-cooled and -moderated reactors are of concern to reactor designers and operators. An investigation at the French Atomic Energy Commission of means for simulating nuclear power excursions led to the development of explosive simulation charges with time-dependent power releases. Release comparable with the maximum BORAX 1 power release is obtained within a given volume. The data are in good agreement with those deduced from experiments performed in the United States on various reactors and have been used to establish likely orders of magnitude for the mechanical structural response. (auth)

27718 DEPOSITS FORMED IN-PILE ON MAGNOX FUEL ELEMENT SURFACES. Blake, A. R.; Bullock, B. L.; Hilton, D. A. (Central Electricity Generating Board, Berkeley, Eng.). J. Brit. Nucl. Energy Soc., 6: 139-43(Apr. 1967).

Deposits removed from splitter cages on fuel elements discharged from the Berkeley and Bradwell reactors were examined. The material on the lower Berkeley fuel elements was identified as partially oxidized and polymerized blower motor oil, while the evidence indicates that the finely divided carbon present on upper elements is derived from the radiolysis of CO. It is concluded that the deposition values obtained were equilibrium values. The ^{35}S activity present on fuel element surfaces was also measured, and it is suggested that this was the result of S transfer from the moderator. (auth)

27719 CONCEPT OF THE EPITHERMAL MOLTEN SALT REACTOR. Barthold, W. P. Atomkernenergie, 12: 5-15(Jan.-Feb. 1967). (In German).

Because of the increasing energy requirements, U reserves can be preserved by using breeders. The reprocessing of the irradiated fuel and its refabrication play an important role for the economics of these reactors. Molten salt reactors use liquid fuel and have a very simple and cheap reprocessing without need for refabrication. The epithermal molten salt reactor MOSEL allows designs with cooling by the blanket melt, Na and Pb. Breeding ratios of 1.1–1.2 and doubling times less than 10 years are possible. (auth)

27720 IMPACT OF ATOMIC ENERGY ON SOCIETY. Cockcroft, John (Churchill Coll., Cambridge, Eng.). At. Energy Rev., 4: Commemorative Issue, 7-14(Dec. 1966).

A summary of the trends in outputs and generating costs of different types of reactors is given. The obstacles in the problem of obtaining power by the fusion of hydrogen isotopes, together with the major advances made, are outlined. Subjects discussed are: the impact of nuclear energy on industrial practice; the possible relaxation of stringent reactor siting regulations; the use of reactors in the desalination of seawater; the application of radiation of food preservation and the sterilization of hospital supplies; the developments in important new tools for the physical sciences; and the impact of atomic energy on life sciences. A summary of the achievements of international cooperation and the major role being played by the IAEA is given. (auth)

27721 NUCLEAR POWER SYSTEMS AND THEIR TECHNICAL POTENTIALITIES. Leipunskii, Alexander (Inst. of Physics and Power, Obninsk, USSR). At. Energy Rev., 4: Commemorative Issue, 41-9(Dec. 1966).

Nuclear plants constitute a significant fraction of the electric power stations now under construction. The author assesses this position and surveys the considerable experience already gained in thermal reactors, particularly the PWR and BWR in USA, the GGR in England and France, the PWR and GBWR in USSR, and the heavy water reactor in Canada. All these reactor systems can be perfected by raising the specific power, by improving and reducing the cost of fuel element fabrication and reprocessing, and by the introduction of superheating in the case of boiling water reactors. Considerable reductions in the fuel component of power costs can be expected from systems with improved neutron utilization: heavy water reactors and gas-graphite reactors with the graphite-based fuel elements. Fast breeders possess the important characteristic of being able to produce more Pu than is burned up. Consequently, the fuel component is cheaper than in any other reactor types and is, to a large extent, independent of the cost of U. With fast breeders both expensive U and Th can be used. When Th is used, best results are obtained with a mixed cycle in which a mixture of ^{233}U, Pu, and ^{238}U is used in the core and Th in the blanket. Operating experience with fast neutron reactors using Na as coolant, the development of Na technology, and trials with fuel elements consisting of UO_2 and PuO_2 have shown that it is possible to design and build a fast neutron reactor capable of supplying power at lower cost than in any other system. At the start-up fast neutron reactors can be loaded with enriched U, which is then progressively replaced by the Pu produced within the breeder reactor system. This is an economically attractive procedure. By the mid-seventies enough experience will have been gained with prototypes represented by the BN-350 reactor under construction at Shevchenko and the PFR at Dounreay for work to begin on constructing high-power, commercial fast breeders. By the end of the seventies we can expect the beginning of fast-breeder construction on a large scale, with reduced construction of thermal neutron reactors. (auth)

27722 COMMERCIAL FUTURE OF NUCLEAR POWER. **Webster, William (New England Electric System, Boston. Yankee Atomic Electric Co., Boston). At. Energy Rev., 4: Commemorative Issue, 51-8(Dec. 1966).**

The use of electric power in the world is increasing rapidly and this growth may be expected to continue for decades. As a result, a six- or eight-fold increase in generating capability must be provided for before the year 2000. It is anticipated that the bulk of future power supply will be based on nuclear and pumped-storage hydro stations. Nuclear power costs for large plants are now competitive in most areas of the world, and reactors are proving reliable and dependable. The flood of orders for major plants in the past year assures the pace of the program and will minimize the effects of a short-range setback if some plants now building should be delayed or prove temporarily disappointing. There is no unanimity as to the best type of thermal reactor. It is anticipated that both water reactors and gas-cooled reactors will continue to be major factors and that other types will be worked on. All of these will become more economical and efficient, and appear in larger sizes, but type selection will continue to be influenced by matters other than relative efficiency and economy. The fast breeder reactor will probably break through to technical and economic feasibility around 1980 and then outrun the thermal reactor in rate of installed capacity. The exact pace of this program is less certain than the final picture. Probably by 1980 over half of the new capacity being built will be nuclear. It will be the main reliance for new central station plants after that. One may anticipate 200,000 to 250,000 megawatts of nuclear power by 1980 and 3- to 4-million megawatts before the year 2000. Towards the end of the century, one should anticipate an equilibrium situation which will be reached first in the more highly industrialized countries. Breeder reactors will be the backbone of the power supply, which will include thermal reactors with plutonium playing an important role as a balancing factor. These will be complemented by pumped-storage hydro plants. There will be a continuing use of fossil fuel plants and conventional hydro. The attainment of this situation will require a tremendous expansion of manufacturing capacity for providing plants and fuel, and separation facilities and other lines. It will call for major adjustments of many sorts, including the adoption of a full system of inspection and licensing; and for its fullest development, it may require financial and trade rearrangements. The author foresees it as leading to a great increase in joint efforts and cooperation and reciprocity between nations and believes this may be a major force for world integration and understanding. (auth)

27723 FUEL SUPPLY PARAMETERS OF REACTORS AND REACTOR SYSTEMS. Gruemm, H. (Oesterreichische Studiengesellschaft fuer Atomenergie GmbH, Vienna). Atomkernenergie, 12: 1-4(Jan.-Feb. 1967). (In German).

The incorporation of a certain reactor type in a growing nuclear energy system is followed by long lasting consequences such as uranium supply, use of separation and reprocessing plants etc. A definition of significant parameters which allows a quick estimate of these consequences for each reactor type is given. (auth)

27724 ANALYTICAL APPROACH TO ACCIDENTAL LOSS OF COOLANT IN BWR. Zdravkovic, M. (Univ., Belgrade). Atomkernenergie, 12: 25-8(Jan.-Feb. 1967). (In German).

If a feed pipe or outlet steam pipe of a power reactor ruptures, sudden discharge of superheated heavy water or steam may be discharged into the dry well where the reactor is located. This is accompanied by sudden and high buildup of pressure which causes further damage. In order to suppress pressure increase and prevent radioactive contamination of the environment, the dry well is connected by special venting pipes to the wet well. A calculational method for theoretical prediction of pressure drop is given, in which the discharge time of the liquid is described by two new dimensionless numbers containing all geometrical and thermophysical parameters of the reactor vessel. (M.L.S.)

27725 AMERICAN HIGH-TEMPERATURE GAS-COOLED REACTOR POWER STATIONS. **Engineer, 223: 724-6(May 12, 1967).**

Progress in the development of HTGR power stations in the U.S. is reviewed. The 40 MW(e) prototype Peach Bottom went into operation recently, and a 330 MW(e) integrated design (Fort St. Vrain) is to be built. Studies have also been made on 600 and 1,000 MW designs. Fuel design and management studies are outlined and the economic considerations are discussed. (UK)

27726 DEVELOPMENT OF METALLIC FUEL ELEMENTS FOR THE FRENCH POWER INDUSTRY. **Englander, Marcel (CEN, Saclay, France). J. Brit. Nucl. Energy Soc., 6: 102-21 (Apr. 1967).**

The design and manufacture of the fuel elements for the French power reactors types G 2/3, EDF 1/2/3, Saint-Laurent 1, and Bugey 1 are reviewed. The hollow rod metallic fuels used in EDF 1 and later designs have undergone successive development with increase of the outer and inner diameters, internal stresses, and maximal temperatures to achieve a specific power of 6 w/g U in the case of the annular fuel of Bugey 1. The history of the development of the Mg—Zr alloy can design is outlined, and brief details are given of out-of-pile and in-pile testing. (UK)

27727 WHY ON-LOAD REFUELLING FOR NUCLEAR REACTORS? Waine, P.; Selby, R. A. (Fairey Engineering Ltd., Eng.). Engineering, 203: 678-81(Apr. 28, 1967).

The philosophy of on-load refuelling used in the nine commercial Magnox stations and in the Dungeness "B" and SGHW designs is outlined and the economic considerations are discussed. The development and manufacture of the systems, including the use of fuel clusters with single channel access, are reviewed. (UK)

27728 OPERATIONAL RELIABILITY OF AEA MAGNOX REACTORS. **Parker, E. (United Kingdom Atomic Energy Authority, Risley, Eng.). J. Brit. Nucl. Energy Soc., 6: 122-6 (Apr. 1967).**

The outstanding achievements of the Calder and Chapelcross reactors in respect of reliability and progressive improvement in performance are briefly summarized, and a five-year period (1961—1965) unaffected by early commissioning and teething troubles is chosen for detailed examination on the basis of data stored in the UKAEA fault reporting system operated by Safeguards Division of the Authority Health and Safety Branch. The analysis shows that nuclear (as opposed to conventional) items of plant only contribute some 14.5% of the outage time due to fault occurrences; and that although control electrical systems and instrumentation provide the largest single contribution to numerical fault totals, the associated outage time is very small. The major part of the outage time due to faults arose in cooling systems, notably main blowers. Only 96 days (2.4 days per reactor per year) were lost during the period under review as a result of plant and equipment faults. (UK)

27729 REACTOR CALCULATIONS FOR AGR. **Blackburn, D.; Sherwin, J.; Tyror, J. G. (Atomic Energy Establishment, Winfrith, Eng.). J. Brit. Nucl. Energy Soc., 6: 144-54(Apr. 1967).**

In design and assessment studies of nuclear power reactors it is necessary to evaluate overall characteristics such as enrichment requirements, power distributions, fuel management strategies, etc. To do this it is necessary to perform reactor calculations in which all fuel channels, absorbers, reflectors, etc. are represented. The methods currently used for performing such calculations for AGR systems are described. (UK)

27730 ANALYSIS OF GRAPHITE MODERATED URANIUM AND PLUTONIUM/URANIUM OXIDE FUEL CLUSTERS USING THE LATTICE CODE WIMS. **Barclay, F. R. (Atomic Energy Establishment, Winfrith, Eng.). J. Brit. Nucl. Energy Soc., 6: 155-60(Apr. 1967).**

The performance of the lattice code WIMS was studied by the analysis of graphite moderated exponential experiments fuelled with clusters of UO_2 or Pu/UO_2 rods at temperatures up to 390°C. Earlier work on single metal rod systems showed that the best agreement in reactivity between U and Pu/U fuel was obtained by using a ^{239}Pu η value of 2.098 (at 2200 m/s). The use of the IAEA recommended η of 2.114 in the work showed a significant dependence of reactivity on ^{239}Pu enrichment, which was largely removed by using an η value of 2.098. (UK)

27731 EVALUATION OF SOME UNCERTAINTIES IN THE COMPARISON BETWEEN THEORY AND EXPERIMENT FOR REGULAR LIGHT WATER LATTICES. **Fayers, F. J.; Kemshell, P. B.; Terry, M. J. (Atomic Energy Establishment, Winfrith, Eng.). J. Brit. Nucl. Energy Soc., 6: 161-81(Apr. 1967).**

The principal factors influencing the accuracy of comparisons between theory and experiment for regular water-moderated lattices are examined. By the use of more elaborate theoretical methods, the accuracy of the physics methods used in the WIMS lattice code is established with regard to leakage, fast fission events in ^{238}U, resonance captures in ^{238}U and thermal disadvantage factors. The difficulty of making corrections for the non-asymptotic nature of the flux to bucklings inferred from measurements in small exponential cores is examined and the validity of a one-dimensional analysis of this effect is questioned. Subject to this limitation it is shown that the computational methods are sufficiently accurate to allow deductions to be made concerning the gross characteristics of fundamental nuclear data through comparison of the predicted reactivities and reaction rates with experiment. Results for a series of UO_2 lattices using both critical and exponential techniques are given and further comparisons are made for a selection of experiments using both UO_2 and U metal fuel. The results of reducing the leakage by poisoning with B in these experiments are also described. The results obtained support the need to introduce a modification to the resonance integrals for ^{238}U as computed from fundamental data, and information is provided on a preferred value for the ratio of epithermal capture to fission in ^{235}U. A pitch-dependent error in the fast fission factor and a discrepancy in temperature coefficient are identified, but efforts to isolate the cause of these errors were not successful. (UK)

27732 MEMORANDUM TO THE SELECT COMMITTEE ON SCIENCE AND TECHNOLOGY. **Penney, William. Atom, No. 127, 94-100(May 1967).**

A review of the UK nuclear reactor programme was presented at the opening session of the Parliamentary Select Committee. Subjects discussed are as follows: present organization of the UKAEA and control of reactor development, the reactor development programme, cost benefit analysis of reactor programme, future developments, fuel supplies, technical advances in reactor design, progress in reactor development in USA, co-operation with European and other countries, the UKAEA's research and development role now and in the future, financing the UKAEA and its commercial activities. (UK)

27733 MEASUREMENT OF THE DOPPLER COEFFICIENT OF FAST REACTORS USING HEATED SAMPLES. **Pucker, Norbert (Univ., Graz). Atomkernenergie, 12: 189-92(May-June 1967).**

The measurement of the Doppler coefficient of a fast reactor due to heating a sample is discussed. The suitability of multigroup diffusion methods for this problem is investigated and results are presented within first order perturbation theory. (auth)

27734 DETERMINATION OF COOLANT AND FUEL ELEMENT SURFACE TEMPERATURE IN A STEAM COOLED REACTOR WITH CONSIDERATION OF HEAT TRANSMISSION BY CONVECTION AND THERMAL RADIATION. **Vecsei, K. Atomkernenergie, 12: 169-78(May-June 1967). (In German).**

A method is given to calculate the longitudinal distribution of steam and fuel element surface temperature in a combined boiling-superheater reactor, if heat transmission by thermal radiation cannot be neglected. Thermal radiation will play a considerable part in heat removal if temperature is increasing or convective heat transfer is reduced. The temperature dependent coefficient of convective heat transfer and specific heat is expressed in approximate equations. The maximal surface temperature, coolant outlet temperature and the influence of thermal can be taken from plots. (auth)

27735 PRIMARY CYCLE DYNAMICS OF A NUCLEAR POWER STATION IN THE SERIES ARRANGEMENT OF MAIN AND ADDITIONAL CIRCULATION BLOWERS. **Mueller, Vladimir; Hrstka, Vladimir; Kalivoda, Radoslav. Jad. Energ., 13: 81-7(Mar. 1967). (In Czech).**

Primary cycle dynamics of a nuclear A-1 type power plant was studied during an emergency shut-down by considering the residual running of the main circulating pumps. A gas-cycle design with series-connected basic and auxiliary pumps is discussed. The principal attention is given to the reactor recooling by the auxiliary pumps, securing a nominal power for the nuclear plant and cooling of the basic construction and screening parts of the reactor. The problem was resolved using an AR-3M modeling device for various circulating pumps with different running force. The results were applied to the selection of suitable cooling schemes for A-2 reactors. (tr-auth)

27736 NUCLEAR FUEL RESOURCES AND PRICE TRENDS. **Bell, D. D. (Eldorado Mining and Refining Ltd., Ottawa). Can. Mining Met. Bull., 60: 450-6(Apr. 1967).**

The history of procurement and demand is presented, with a look at future requirements. The three basic conclusions drawn are: the productive capacity of former and existing producers whose operations may be profitably reactivated is insufficient to meet demand projected beyond 1975; reserves in the $5 to $10 price range do not provide the flexibility to sustain production at the high rates required in the late 1970's; and only higher prices can overcome these deficiencies, as this would provide sufficient inducement for the industry to explore for and develop new reserves and productive capacity. (auth)

27737 OPTIMIZATION OF REACTOR CONTROL SYSTEMS BY WIENER'S THEORY. **Miyazaki, Keiji (Osaka Univ.). J. Nucl. Sci. Technol. (Tokyo), 4: 107-14(Mar. 1967).**

Wiener's theory of least square optimization with quadratic constraint has been applied to reactor control system design. Stochastic and deterministic cases are treated here, taking white disturbance of reactivity and step reference input as examples. The mean square and integral square errors have been minimized subject to the constraint on the reactivity rate controlled externally for white noise and step input respectively. The reactor transfer function is based on linear approximation for single-group delayed neutrons with no feedback of reactivity. Numerical calculations have been performed for effective neutron lifetimes in the range from 10^{-3} to 10^{-5} sec, and the resulting optimized controllers are physically realizable. Analytical results with an analog computer indicate—in the case of $l^* = 10^{-1}$ sec—that the transient responses of the optimized control systems are excellent for step inputs and that a considerable reduction in the output fluctuation is obtainable for white noise, granted a large peak of reactivity rate with a small value of reactivity. (auth)

27738 NUCLEAR POWER: POLICY AND PROSPECTS. **Seaborg, Glen T. (Atomic Energy Commission, Washington, D. C.). Nucl. Energy, 58-61(Mar.-Apr. 1967).**

The growth of nuclear power and the policy associated with its growth are discussed, and the place of advanced convertors and breeders in future development is considered. Mention is also made of the potentialities of solar energy, controlled fusion, and MHD conversion. (UK)

27739 INVESTIGATIONS ON THE ROSSI α EXPERIMENT. Schulze, Ekhard (Technische Hochschule, Darmstadt, Ger.). Nukleonik, 9: 85-97(Feb. 1967). (In German).

The Rossi α measurements which are in opposition to theory were described. Results of Monte Carlo calculations show that the basis for the discrepancies is not to be found in reactor kinetics. An extensive analysis shows that the physical bases of the Rossi α experiment have not been formulated rigidly enough up to the present. The mean time pattern of a neutron chain can be described through a decaying exponential function. Since only such neutron chains can be used experimentally which lead at least to an event, such chains were preferentially recorded which increase by an above average number of fissions. In this way, one of the exponential functions of average deviating time behavior was produced. This is not considered in the common theory. By the counting process, a new model representation was given and was developed formally. The theoretical considerations therefore lead to Rossi α experiments with special conditions which give a higher ratio and correlation term and background. As an application of the Rossi α measurements, a method for the determination of β/L was given in which no reactivity measurements were necessary. The theory of the Feynman α experiment was not used in the proposed new interpretation of the Rossi α experiment. (tr-auth)

27740 THE USE OF BURNABLE POISONS IN AGR INITIAL FUEL. Carpenter, E. W. (Central Electricity Generating Board, Bristol, Eng.). Nucl. Eng., 12: 298-300(Apr. 1967).

The fuel management problem of the transition from all new fuel to the equilibrium situation is outlined in simple terms and one possible solution, the use of burnable poisons, is described in some detail. It is concluded that the possibilities are sufficiently attractive to warrant the continued development of the necessary techniques. (UK)

27741 PROCEEDINGS OF THE AMERICAN POWER CONFERENCE. **VOLUME XXVIII.** Proc. Amer. Power Conf., 28: 1-1136(1966). (CONF-660429).

Separate abstracts were prepared for 9 of the included papers. For abstracts of the remaining papers see CONF-660429 in the report number index. (M.O.W.)

For abstracts of individual papers see: 26032, 27038, 27742–27747, and 27838.

27742 STEAM CYCLE CONSIDERATIONS FOR LARGE HEAVY WATER-MODERATED ORGANIC-COOLED REACTOR PLANTS. **Falcon, J. A.; Jacobson, J. (Atomics International, Canoga Park, Calif.). Proc. Amer. Power Conf., 28: 126-38 (1966).**

A description and background of the HWOCR is given. The results of steam cycle studies is presented. Data on base case alternatives, reheat plant technical problems, and economic evaluation is tabulated. (M.L.S.)

27743 TURBINE-GENERATOR FOR THE OYSTER CREEK STATION. **Miller, E. H.; Winchester, R. L. (General Electric Co., Schenectady, N. Y.). Proc. Amer. Power Conf., 28: 180-9(1966).**

A detailed description of the Oyster Creek Station turbine-generator is given. Topics discussed are: high-pressure turbine, low-pressure turbine, moisture separators, steam reheaters, valves, stator design, rotor design, and excitation system. (M.L.S.)

27744 INDIAN POINT UNIT NO. 1 CORE A PERFORMANCE SUMMARY. **Prestele, J. A. (Consolidated Edison Co. of New**

York, Inc., New York) Edlund, M. C. Proc. Amer. Power Conf., 28: 200-7(1966).

A general survey of the Indian Point I Core A performance is given. Comparisons of measured and calculated reactivity coefficients are tabulated; power peaking factors are listed; comparisons of design and calculated thermal and hydraulic parameters are made. Each of the tables is discussed. (M.L.S.)

27745 BONUS OPERATING EXPERIENCE. West, J. M. (Combustion Engineering, Inc., Windsor, Conn.); Fragoso, J. H. Proc. Amer. Power Conf., 28: 208-24(1966).

A description of BONUS is given. A history of operation is presented; the various systems are treated individually. The problem of the waterlogging of superheater fuel elements is discussed. The in-plant and liquid waste radioactivity levels and the radiolytic and radioactive gas disposal systems are briefly considered. Feedwater and steam flow regulation, scram history, control rod drives, and power splits are each discussed briefly. (M.L.S.)

27746 OPERATING AND MAINTENANCE EXPERIENCE WITH BWR POWER PLANTS. Hoyt, H. K. (Commonwealth Edison Co., Chicago); Ascherl, R. J.; Cox, B. T. Proc. Amer. Power Conf., 28: 225-40(1966).

An operating history of Dresden Power Station through four fuel cycles is given. The significant power outages which have occurred are discussed. Refueling operations are briefly outlined. (M.L.S.)

27747 OPERATING EXPERIENCE WITH LARGE SODIUM-COOLED REACTOR PLANTS. Cochran, J. D. (Consumer's Public Power District, Hallam, Neb.); Monson, H. O.; Owens, J. E. Proc. Amer. Power Conf., 28: 241-56(1966).

The operations history of large Na-cooled reactors is considered. The four Na-cooled, the SRE, HNPF, Enrico Fermi, and EBR-II, are listed; descriptions of each are given. A summary of experience gained from these is presented. (M.L.S.)

27748 PHYSICS MEASUREMENTS IN OPERATING POWER REACTORS. Proceedings of an International Seminar held in Rome, 9th-13th May 1966. Paris, European Nuclear Energy Agency, 1967. 843p. FF 92; FS 84; DM 76,50; Pound 6.14s; $22.00. (CONF-660562).

Twenty-six separate articles on physics measurements in both thermal and fast reactors are included. These treat the subjects of measurements of reactivity, void and temperature coefficients, reactivity feedback, and fuel burnup analysis. The development of instrumentation to facilitate these measurements is described. Economic aspects of testing programs are considered and conclusions are drawn. Separate abstracts were prepared for each of the twenty-six papers included. (M.L.S.)

For abstracts of individual papers see: 27749–27774.

27749 PROCUREMENT OF REACTOR PHYSICS DATA FROM OPERATING POWER REACTORS. Eriksen, V. O. (Institutt for Atomenergi, Kjeller, Norway); Went, J. J. pp 9-33 of Physics Measurements in Operating Power Reactors. Paris, European Nuclear Energy Agency, 1967.

From Proceedings of Physics Measurements in Operating Power Reactors, Rome. See CONF-660562.

A comprehensive discussion of the role of reactor physics measurements in power reactors is presented. The types of experiments of use in power reactors are outlined. The advantages and economics of reactor physics experiments are generally discussed. (M.L.S.)

27750 PHYSICS MEASUREMENTS IN OPERATING BOILING AND PRESSURIZED WATER REACTORS. Thompson, T. J. (Massachusetts Inst. of Tech., Cambridge). pp 45-71 of Physics Measurements in Operating Power Reactors. Paris, European Nuclear Energy Agency, 1967.

From Proceedings of Physics Measurements in Operating Power Reactors, Rome. See CONF-660562.

The general objectives of physics measurements in power reactors are outlined. The use of reactor physics for determination of characteristics for boiling water and pressurized water reactors is discussed. The application of present physics measurements to the design of future reactors is given. Measurements for use as reactor safety aids are discussed. The types of reactor physics experiments are outlined. (M.L.S.)

27751 PHYSICS MEASUREMENTS IN AN OPERATING FAST BREEDER POWER REACTOR. Persiani, P. J.; Smith, R. R.; Okrent, D. (Argonne National Lab., Ill.). pp 73-107 of Physics Measurements in Operating Power Reactors. Paris, European Nuclear Energy Agency, 1967.

From Proceedings of Physics Measurements in Operating Power Reactors, Rome. See CONF-660562.

Physics measurements, as they pertain to the economics and operation of fast breeder reactors, are discussed. The variations of cold, clean core measurements with irradiation history are considered for the breeder reactor. Tabulated data for performance of three types of fast breeder reactors are given. Results of four independent studies on Na-cooled fast reactors are presented. Inter-comparison calculations of two oxide core compositions are listed; breeding ratio as a function of burnup is given; reaction rate and delayed-neutron fraction variations are summarized. Reactivity coefficient and power changes for ramp insertions are given. (M.L.S.)

27752 ROLE OF PHYSICS MEASUREMENTS IN THE POWER REACTORS OF THE NATURAL U, GRAPHITE SERIES. Bacher, P.; Pelce, J. (Commissariat a l'Energie Atomique, Saclay, France). pp 119-52 of Physics Measurements in Operating Power Reactors. Paris, European Nuclear Energy Agency, 1967. (In French).

From Proceedings of Physics Measurements in Operating Power Reactors, Rome. See CONF-660562.

After a review of the fact that the principal limitations on the performance of natural U, graphite nuclear power plants come from the maximum temperature tolerated by the cladding and from the low potential reactivity of the system, the economic interest of reconciling as much as possible the actual operational conditions of these values was emphasized. A detailed examination was made of studies and tests which should be undertaken for this purpose. The means of knowing better the transients and of defining the neutron conditions of the reactor were also examined. The report is divided into three parts: the totality of the problems connected with the distribution of temperatures in the reactor; the problems connected with the evolution of the neutron properties of the fuel with irradiation; and the kinetics of this type of reactor. (tr-auth)

27753 ROLE OF PHYSICS MEASUREMENTS IN POWER REACTORS, WITH SPECIAL REFERENCE TO SYSTEMS IN OPERATION IN THE UNITED KINGDOM. Hughes, H. A. (United Kingdom Atomic Energy Authority, London); Gallie, R. R.; Smith, D. C. G.; Clinch, D. A. L. pp 153-63 of Physics Measurements in Operating Power Reactors. Paris, European Nuclear Energy Agency, 1967.

From Proceedings of Physics Measurements in Operating Power Reactors, Rome. See CONF-660562.

The experimental role of reactor physics measurements in power reactors is examined, with special emphasis on the British experimental program. The basis for setting up an experimental physics measurements program for any power reactor is discussed. The advantages to be gained from an experimental program are examined. (M.L.S.)

27754 EXPERIMENTAL ASSESSMENT OF CORE PERFORMANCE UNDER NORMAL OPERATING CONDITIONS AND VERIFICATION OF SAFETY MARGINS AT INCREASED OUTPUT IN THE GARIGLIANO BOILING WATER REACTOR POWER STATION. Mirone, M. (Ente Nazionale per l'Energia Elettrica, Rome); Santasilia, F.; Colling, A. pp 175-91 of Physics Measurements in Operating Power Reactors. Paris, European Nuclear Energy Agency, 1967.

From Proceedings of Physics Measurements in Operating Power Reactors, Rome. See CONF-660562.

A description of the equipment and special test instrumentation for the ENEL research program at Garigliano BWR is described. Data collected during nominal operating conditions and information from the gamma scanning of fuel elements after shutdown are given. (M.L.S.)

27755 PHYSICS MEASUREMENTS AT STARTUP AND OPERATING LEVEL IN THE KAHL REACTOR. Schmale, H. (Rheinisch-Westfaelisches Elektricitaetswerk, Essen). pp 197-210 of Physics Measurements in Operating Power Reactors. Paris, European Nuclear Energy Agency, 1967.

From Proceedings of Physics Measurements in Operating Power Reactors, Rome. See CONF-660562.

A detailed report of the reactor physics tests at the Kahl Reactor is given. The results obtained from the tests are given, and the utility of the program is assessed. A brief operational history of the reactor is presented. (M.L.S.)

27756 PHYSICS TESTS AT THE DRESDEN NUCLEAR POWER STATION. Kosmata, A. R.; Kanne, W. R. (General Electric Co., San Jose, Calif.). pp 215-63 of Physics Measurements in Operating Power Reactors. Paris, European Nuclear Energy Agency, 1967.

From Proceedings of Physics Measurements in Operating Power Reactors, Rome. See CONF-660562.

A description of the extensive experimental program of Dresden is given. The purposes of the program are presented, and some Dresden core data are appended to provide a basis for evaluation of experimental results. Considerable emphasis is placed on control measurements and power distribution measurements since there are some basic differences between a large BWR and its corresponding cold critical facility. The economic aspects of the testing program are discussed briefly. (M.L.S.)

27757 POWER ESCALATION EXPERIMENTS FOR THE E. FERMI PRESSURIZED WATER REACTOR PLANT. Camplani, A.; Giuriato, A. (Ente Nazionale per l'Energia Elettrica, Rome). pp 271-83 of Physics Measurements in Operating Power Reactors. Paris, European Nuclear Energy Agency, 1967.
From Proceedings of Physics Measurements in Operating Power Reactors, Rome. See CONF-660562.

Experiments performed during the increase of power from 615–825 MW(t) are discussed. Particular attention is focused on the neutron flux mapping system and the nuclear instrumentation. The uses of the computer system are emphasized. (M.L.S.)

27758 REACTOR PHYSICS MEASUREMENTS IN PRESSURIZED WATER REACTORS. Graves, H. W. Jr. (Westinghouse Atomic Power Div., Pittsburgh). pp 289-300 of Physics Measurements in Operating Power Reactors. Paris, European Nuclear Energy Agency, 1967.
From Proceedings of Physics Measurements in Operating Power Reactors, Rome. See CONF-660562.

The significance of reactor physics measurements in pressurized water reactors is given detailed evaluation. The advance of the technology of the two significant tools of in-core instrumentation and reactivity computer is discussed; their contribution to the measurements are assessed. Data on burnup distribution analysis performed for both destructive testing of discharged fuel and gamma scanning of spent fuel is presented. Reactivity measurements from three pressurized water reactors are discussed. (M.L.S.)

27759 REACTIVITY MEASUREMENTS ON NPD. Whittier, A. C. (Canadian General Electric Co., Peterborough, Ont.). pp 307-33 of Physics Measurements in Operating Power Reactors. Paris, European Nuclear Energy Agency, 1967.
From Proceedings of Physics Measurements in Operating Power Reactors, Rome. See CONF-660562.

A description of the Nuclear Power Demonstration Reactor is given; measurements which have been made are discussed in some detail. Data are also presented for reactivity change and temperature effects on this. Fuel burnup, fuel shifts, and effects of new fuel introduced during operation are discussed. (M.L.S.)

27760 PHYSICS EXPERIMENTS AT THE AGESTA POWER STATION. Bliselius, P. A. (Aktiebolaget Atomenergi, Studsvik, Sweden); Akerhielm, F.; Apelqvist, G.; Blomberg, P. E.; Jonsson, E. pp 339-67 of Physics Measurements in Operating Power Reactors. Paris, European Nuclear Energy Agency, 1967.
From Proceedings of Physics Measurements in Operating Power Reactors, Rome. See CONF-660562.

Experimental measurements have been made at the Agesta Reactor for the purpose of determining experimental procedures and equipment and for measuring the dynamic characteristics of the reactor. Trapezoidal and step functions and two types of periodic multifrequency signals were used as perturbation functions for experimental purposes. Experimental results are compared with dynamic calculations. Reactor noise analysis experience in Agesta is discussed. Static measurements were made to confirm theoretical methods for reactor calculations and to ensure safe operation of the reactor. Reactivity worths of control rod groups were calculated by three-dimensional analysis; xenon poisoning effects were examined; power distribution measurements were made. Burnup distribution and flux five-structure measurements are discussed. (M.L.S.)

27761 REVIEW OF PHYSICS MEASUREMENTS AT CALDER AND CHAPELCROSS. Hughes, H. A.; Jenkinson, P. (United Kingdom Atomic Energy Authority, Sellafield, Eng.). pp 373-85 of Physics Measurements in Operating Power Reactors. Paris, European Nuclear Energy Agency, 1967.
From Proceedings of Physics Measurements in Operating Power Reactors, Rome. See CONF-660562.

Measurements of long-term reactivity changes for two separate fuel loadings for Calder Hall and Chapelcross, operating at full power, were made. These are compared with theory. A similar comparison is made for temperature coefficients and power coefficients. Control rod calibration measurements were made at low power; radiation effects on control rod capacity were then studied over extended exposure. Temperature measurements, which were then used for complete temperature distribution calculations, are described. A discussion of application of these measurements to reactor safety is presented. (M.L.S.)

27762 PHYSICS MEASUREMENTS IN OPERATIONAL CEGB NUCLEAR POWER REACTORS. Rutter, R. L.; Reid, J. J. (Central Electricity Generating Board, London). pp 393-410 of Physics Measurements in Operating Power Reactors. Paris, European Nuclear Energy Agency, 1967.
From Proceedings of Physics Measurements in Operating Power Reactors, Rome. See CONF-660562.

A survey of the British Power Reactors and the investigation of their various nuclear characteristics is described. The scope and direction of measurements made presently are discussed. (M.L.S.)

27763 REACTOR PHYSICS MEASUREMENTS ON THE WINDSCALE ADVANCED GAS-COOLED REACTOR (AGR) SINCE ACHIEVING FULL POWER OPERATION. Gallie, R. R. (United Kingdom Atomic Energy Authority, Sellafield, Eng.). pp 417-53 of Physics Measurements in Operating Power Reactors. Paris, European Nuclear Energy Agency, 1967.
From Proceedings of Physics Measurements in Operating Power Reactors, Rome. See CONF-660562.

The methods and precision of determining channel power output and axial power distribution are discussed and compared with various methods of calculation. The method of determining control rod calibrations as a function of irradiation by using the Xe transient following a shutdown is described; the two-dimensional method used for control rod calibration calculations is examined. Xe poisoning measurements and long term reactivity changes are compared with theory; three methods used for determining temperature coefficients are described. Small perturbation kinetic experiments and oscillator experiments are described; agreement of experiment and simple point model calculations are discussed. The factorial design behind the siting of the thermocouples on the fuel pins is described and the type of information obtainable from an analysis of this thermocouple information is indicated. (M.L.S.)

27764 EXPERIMENTAL DETERMINATION OF CORE REACTIVITY BUILD-UP WITH IRRADIATION IN THE LATINA NUCLEAR POWER PLANT. Bertini, A. (Ente Nazionale per l'Energia Elettrica, Rome); La Parola, G. Lesnoni; Montois, P.; Pleinevaux, C. pp 459-70 of Physics Measurements in Operating Power Reactors. Paris, European Nuclear Energy Agency, 1967.
From Proceedings of Physics Measurements in Operating Power Reactors, Rome. See CONF-660562.

The results of a long-range experimental program to determine the evolution of core reactivity with irradiation are given. Measurements were also made to assess the validity of theoretical core design and behavior predictions. (M.L.S.)

27765 OPTIMIZATION OF THE POWER OF THE G2 AND G3 REACTORS. Martin, D.; Obstancias, H.; Feidt, G.; Decool, F.; Fenart, H. (Commissariat a l'Energie Atomique, Marcoule, France). pp 475-506 of Physics Measurements in Operating Power Reactors. Paris, European Nuclear Energy Agency, 1967. (In French).
From Proceedings of Physics Measurements in Operating Power Reactors, Rome. See CONF-660562.

The power of the G2 and G3 reactors, designed as 100 to 200 Mw, has attained this last level from its first startup. It is now maintained at 260 Mw. The role played in the gaining of these results by physical measurements made on G2 and G3 in operation is shown. After a brief review of the control parameters, it is shown how measurements of temperature and flux have made it possible to realize numerous experiences leading to the power increase or to greater safety. These experiments have concerned principally the radial flattening and the optimum axial transport of the thermal flux. This was obtained by charging absorbents in an unsymmetrical fashion in some reactor channels. Other experiments were also described: utilization of depleted U, selection of rods for control, study of a new cladding profile, and experimental verification of calculation codes. The balance shows the sharp increase of power of the reactors that can be obtained while remaining completely within safety limits. (tr-auth)

27766 PHYSICAL TESTS ON THE CHINON REACTORS. Etienne, P.; Noc, B.; Touyeras, J. (Electricite de France, Nantes, Fontenay-aux-Roses, and Clamart, France). pp 511-49 of Physics Measurements in Operating Power Reactors. Paris, European Nuclear Energy Agency, 1967. (In French).
From Proceedings of Physics Measurements in Operating Power Reactors, Rome. See CONF-660562.

The importance of the construction program of nuclear power plants of the graphite-gas series has lead to an examination of the aims of physical tests in the development of the series and the consistence of these tests for the these reactors installed at Chinon. New methods of investigation were studied and then adapted in order to reduce the time involved in testing the reactors during their power rise. Moreover the physical tests made on reactors in operation are conducted such that the energy production of the installation is perturbed as little as possible. The first part of the present study describes some physical tests made during the startup and power rise of the E.D.F.1 and E.D.F.2 reactors and partially of the E.D.F.3 reactor. The results of the tests as well as the variations from the values calculated are reported. Beginning with two series of tests which form the cold testing and the testing during the power rise, there is a critical examination of the utility of these tests. The very complete test made on the first Chinon reactor, an experimental installation constructed and operated with the purpose of developing high power reactors, were not made on the E.D.F.2 in their entirety. Tests on future reactors that can result in a reduction of the time necessary for the test are proposed. The second part of the report is devoted to an attempt to define the objectives of the physical tests made periodically during its operation. The aims to be attained are: The optimization of the functioning of the reactor both with respect to the power reduction and fuel renewal and study of data necessary to adapt the theoretical models used for neutron calculations. The tests made in permanent and voluntarily disturbed areas are described. Comparisons are established between the different methods used for the measurement of the temperature coefficients. These tests examined the behavior of the two Chinon reactors whose reactivity is in evolution. It is difficult to predict the exact incidence of the stabilization of reactivity on the volume of physical tests during operation but it is certain that the attainment of reactivity equilibrium will cause an important spacing in the testing outline. In the third part the cost of physical tests during operation is examined. (tr-auth)

27767 PHYSICS MEASUREMENT PROGRAMS IN US FAST POWER REACTORS. Nims, J. B. (Atomic Power Development Associates Inc., Detroit); Klickman, A. E.; McCarthy, W. J.; Kirn, F. S.; Loewenstein, W. B. pp 555-642 of Physics Measurements in Operating Power Reactors. Paris, European Nuclear Energy Agency, 1967.

From Proceedings of Physics Measurements in Operating Power Reactors, Rome. See CONF-660562.

A brief history of the EBR-II and Enrico Fermi Reactor is presented. The physics measurements made in these reactors are described. In Fermi special emphasis was placed on reactivity worths of blanket and fuel materials; Na worths were also measured. Some typical rod-drop data are presented in tabular form. The flow dependence of reactivity measurements was determined; pressure coefficient of reactivity values are tabulated. Tables of safety rod worths are given. The Fermi power escalation program is presented in some detail. A tabular comparison of predicted and measured nuclear parameters for the EBR-II is given. A somewhat generalized discussion of the EBR-II high-power tests is presented. (M.L.S.)

27768 PHYSICS MEASUREMENTS ON A POWER PRODUCING FAST REACTOR. Smith, D. C. G. (United Kingdom Atomic Energy Authority, Winfrith, Eng.). pp 649-60 of Physics Measurements in Operating Power Reactors. Paris, European Nuclear Energy Agency, 1967.

From Proceedings of Physics Measurements in Operating Power Reactors, Rome. See CONF-660562.

A general survey of the types of measurements that are useful to fast power reactors is given. Measurements made in Dounreay are discussed at length. These measurements include determination of reaction rates, power density, temperature and coolant flow, sub-critical reactivity, reactivity changes with burnup, and reactivity feedback. The economics of such measurements in fast power reactors is also considered. (M.L.S.)

27769 INSTRUMENTATION IN THE GRAPHITE REACTORS. Teste du Bailler, A.; Pierre, B. (Commissariat a l'Energie Atomique, Saclay, France). pp 669-702 of Physics Measurements in Operating Power Reactors. Paris, European Nuclear Energy Agency, 1967.

From Proceedings of Physics Measurements in Operating Power Reactors, Rome. See CONF-660562.

The series of natural U graphite-moderated and CO_2-cooled reactors has entered the operation phase for the first high power nuclear installation in France. This phase coincides with that of recent projects of new power plants capable of furnishing electricity at a better price. It is suitable therefore to emphasize the technical data acquired during the operation of the first units in order to adjust better the performances and costs of these new power plants. With respect to the reactor itself, a very important item in the cost analysis is instrumentation, the cost of which varies greatly in different studies. The present study attempts to define the exact role of this instrumentation in reactors. The magnitudes to be measured and the performances required of the instrumentation are defined. The materials used are described and illustrated by some results. The cost of the reactor self measurements and the present tendency in France toward a minimum of useful instrumentation are evaluated. (tr-auth)

27770 PHYSICS MEASUREMENTS AND THE APPLICATION OF IN-CORE INSTRUMENTS IN THE HALDEN HEAVY WATER BOILING REACTOR. Lunde, Jan E. (OECD Halden Reactor Project, Halden, Norway). pp 709-35 of Physics Measurements in Operating Power Reactors. Paris, European Nuclear Energy Agency, 1967.

From Proceedings of Physics Measurements in Operating Power Reactors, Rome. See CONF-660562.

An experimental program to enable realistic evaluation of the obtainable power limits density in the Halden Heavy Water Boiling Reactor is discussed. Studies of a low frequency instability caused by moderator void and temperature effects and a hydrodynamic instability occurring in boiling channels were made. The bulk of the testing was accomplished by in-core instrumentation. A generalized discussion of this instrumentation is given. In-pile and out-of-pile calibrations are discussed. (M.L.S.)

27771 IN CORE INSTRUMENTATION IN LARGE BWRs FOR THE OPTIMIZATION OF THE POWER DISTRIBUTION. Wolff, U. (Allgemeine Elektricitaets Gesellschaft, Frankfurt am Main). pp 743-51 of Physics Measurements in Operating Power Reactors. Paris, European Nuclear Energy Agency, 1967.

From Proceedings of Physics Measurements in Operating Power Reactors, Rome. See CONF-660562.

The development of in-core instrumentation for large boiling water reactors is discussed. A neutron flux monitoring system comprised of miniature detectors distributed throughout the core is described. The sensitivity changes due to burnup and the compensation for this are discussed. The calibration procedures for the system are described. (M.L.S.)

27772 IN-CORE INSTRUMENTATION IN THE MARVIKEN REACTOR. Akerhielm, F. (Aktiebolaget Atomenergi, Studsvik, Sweden); Johansson, E. pp 763-9 of Physics Measurements in Operating Power Reactors. Paris, European Nuclear Energy Agency, 1967.

From Proceedings of Physics Measurements in Operating Power Reactors, Rome. See CONF-660562.

A brief description of the Marviken reactor is given; in-core instrumentation is discussed. The use of this in-core instrumentation for physics measurements is briefly discussed. (M.L.S.)

27773 ECONOMIC IMPLICATIONS OF PHYSICS MEASUREMENTS IN OPERATING POWER REACTORS. Minnick, L. E. (Yankee Atomic Electric Co., Boston). pp 779-89 of Physics Measurements in Operating Power Reactors. Paris, European Nuclear Energy Agency, 1967.

From Proceedings of Physics Measurements in Operating Power Reactors, Rome. See CONF-660562.

An economic evaluation of the physics measurements program in the Yankee Power Reactor is given. An analysis of cost versus benefit is presented. (M.L.S.)

27774 MAIN FUNCTIONS OF DIGITAL COMPUTERS IN THE ENEL NUCLEAR POWER PLANTS. Velona, F. (Ente Nazionale per l'Energia Elettrica, Rome). pp 803-13 of Physics Measurements in Operating Power Reactors. Paris, European Nuclear Energy Agency, 1967.

From Proceedings of Physics Measurements in Operating Power Reactors, Rome. See CONF-660562.

The main objectives of the use of on-line computers at nuclear power stations are presented. The use of computers for continuous physics measurements is discussed, especially for large reactors. Insurance of safety margins by using computers is discussed. (M.L.S.)

27775 FLUID DYNAMICAL ANALYSIS ASSOCIATED WITH A NEW CONCEPT FOR NUCLEAR REACTOR CONTAINMENT. Sorensen, Harold Charles. Lincoln, Neb., Univ. of Nebraska, 1966. 138p.

Thesis.

A fluid dynamical analysis is made for an idealized reactor system having spherical symmetry in order to determine the effect that the destructive component of a nuclear accident produces on a new type of primary containment structure. The destructive component is assumed equivalent to that produced by the detonation of a charge of TNT. This new structure is a result of a new concept for nuclear reactor containment by energy absorption. It is the concrete biological shield in which non-prestressed, unbonded, high strength steel strands are embedded. The new containment concept is based on the energy absorbing capability of the strands. The partial differential equations describing the fluid motion are based upon the von Neumann-Richtmeyer artificial viscosity technique and are presented in Lagrangian form. A numerical solution based upon finite-difference approximations of these partial differential equations is obtained. All computer programs used in obtaining the numerical solution are written in FORTRAN

IV computer language. The solution for an example problem is given The results of this numerical solution are interpreted. From these results, the effect that the destructive component produces on the concrete containment structure is determined and discussed. Suggestions for improvements in the analysis are also mentioned. (auth)

27776 SUPERHEATING OF STEAM IN NUCLEAR REACTORS. Straat, Matts Valter (to Aktiebolaget Atomenergi). British Patent 1,069,032. May 17, 1967. Priority date Dec. 4, 1962, Sweden.

A design for a boiling water reactor is given. Steam is generated in heating elements arranged adjacent to the core. These auxiliary heating elements contain fissile material and make use of the leakage flux from the core. (M.L.S.)

27777 HETEROGENEOUS NUCLEAR REACTOR OF THE PRESSURE VESSEL TYPE. (to Siemens-Schuckertwerke Aktiengesellschaft). British Patent 1, 069,016. May 17, 1967. Priority date Aug. 8, 1964, Germany.

A design is given for a supercritical steam and pressure heterogeneous reactor of the pressure-vessel type which has moderator tubes conducting a part of the moderator and coolant. The operation of the reactor is accomplished by regulating valves in the supply conduits and fixed-setting throttling elements in the moderator tubes. (M.L.S.)

27778 ORGANIC FLUIDS FOR UTILIZATION IN NUCLEAR REACTORS EITHER AS HEAT-TRANSFER FLUIDS OR AS NEUTRON-MODERATING OR REFLECTING FLUIDS. Giuliani, Pierre (to Commissariat a l'Energie Atomique). British Patent 1,068,537. May 10, 1967. Priority date June 28, 1963, France.

An organic fluid is provided in a nuclear reactor as a heat-transfer medium, neutron-moderating or neutron-reflecting medium, characterized in that it consists of a mixture of an unsubstituted terphenyl with alkyl aromatic hydrocarbons of petroleum origin. (J.C.W.)

27779 NUCLEAR REACTOR WITH EMERGENCY COOLANT CROSS FLOW. (to United States Atomic Energy Commission). British Patent 1,067,909. May 3, 1967. Priority date Mar. 29, 1965, United States.

An emergency coolant cross flow design is described in a nuclear reactor. The coolant flows across the fuel rods during an emergency such as an increase in reactivity within the reactor, thus voiding the coolant. Shaping of the individual fuel rods and arranging the fuel and moderator portions are discussed. (J.C.W.)

27780 NUCLEAR REACTOR CONTROL METHOD AND MEANS. (to Kabushiki Kaisha Hitachi Seisakusho). British Patent 1,067,523. May 3, 1967. Priority date Oct. 18, 1962, Japan.

The safety control of a thermal reactor is described. One or more neutron absorbing elements having a resonance absorption energy level in a range from the normal thermal neutron region to 10 eV are applied. (J.C.W.)

27781 IMPROVEMENTS IN NUCLEAR REACTORS. Deighton, Thomas (to Babcock and Wilcox Ltd.). British Patent 1,067,551. May 3, 1967. Filed Nov. 29, 1962.

A liquid-cooled reactor with fuel elements positioned by a lower support and removable upper support is described. Vertically movable reactor control rods are arranged in spaces between adjacent fuel elements. (J.C.W.)

27782 PHYSIQUE DES REACTEURS NUCLEAIRES. VIIe COURS DE PERFECTIONNEMENT DE L'ASSOCIATION VAUDOISE DES CHERCHEURS EN PHYSIQUE. (Nuclear Reactor Physics. 7th Refresher Course of the Vaudoise Association on Research in Physics). Lausanne, Switzerland, Association Vaudoise Chercheurs en Physique, 1965. 368p.

Information for use in a refresher course on nuclear reactor physics is presented. The topics discussed are a description of experiments on critical assemblies at the CEA, technique of pulsed neutrons applied to studies of reactor physics, cross sections measured by oscillations, startup problems in graphite-gas power reactors, methods of reactor calculations, thermalization of neutrons in homogeneous and heterogeneous media, the problem of leaks and the migration of neutrons in the thermalization region, the source-sink method in reactor physics, heterogeneous theory in critical and subcritical facilities, and study of the fast fission factor by the microcell method. (J.S.R.)

Marine and Portable Power Reactors

Refer also to abstract 26023.

27783 (ORNL-TM-1844) WATER CHEMISTRY IN THE N.S. SAVANNAH REACTOR: EFFECT OF A CORE COMPONENT CHANGE FROM 304 STAINLESS STEEL TO ZIRCALOY-4. Whitmarsh, C. L. (Oak Ridge National Lab., Tenn.). Apr. 28, 1967. Contract W-7405-eng-26. 11p. Dep. CFSTI.

Effect of changing the material of construction of the fuel element container, a structural component in the core of the N.S. SAVANNAH reactor, from 304 stainless steel to Zircaloy-4 was considered with respect to the water chemistry of the primary coolant system. No detrimental effects could be foreseen from the standpoints of crud characteristics and chemical effects on material properties. (auth)

27784 SUBMARINE CARGO TRAINS, WITH ARRANGEMENTS FOR THE USE OF OBSOLETE OR SURPLUS NUCLEAR SUBMARINES. Pedrick, Arthur Paul. British Patent 1,067,703. May 3, 1967. Filed Jan. 17, 1966.

A submarine cargo train is proposed for carrying grain to the Far East in the year 2000 AD. The train is powered by existing nuclear submarines, and the submarine is coupled to a train of vessels having substantially the same cross section throughout the train. The vessels have an outer shell and inner shells or load containers. The load containers are of a size suitable for lifting out of the outer shell and forming loads for individual truck or land railway systems. A suction line extends from the towing craft throughout the train so that sea water let into the space between the outer and inner shells of the vessels can be pumped out automatically to adjust the bouyancy of the individual vessels in the train. (B.L.M.)

Rocket and Space Reactors

Refer also to abstract 26747.

27785 (NAA-SR-12316) PROGRESS REPORT FOR SNAP GENERAL SUPPORTING TECHNOLOGY, NOVEMBER 1966–JANUARY 1967. Mims, L. S. (Atomics International, Canoga Park, Calif.). May 5, 1967. Contract AT(04-3)-701. 82p. Dep. CFSTI.

A summary of supporting technology for the SNAP program is given. The following areas of concentration are covered: reactor physics analyses including comparison of Be photoneutron decay sets, transport theory synthesis, cross section updating, and LOAFER documentation; dc conduction pump development; basic shielding analysis including STIR-experiments planning and analysis and shield code development; basic shielding experiments; basic shield materials technology including gamma shield development and lithium hydride technology; SNAP 10A FS-3 post test examination including both internal and external reflectors, core hold-down springs, handle bars, and reflector band; supersaturation studies with both cloud chamber and nozzle expansion. An evaluation of effort expended is presented. (M.L.S.)

27786 (NAA-SR-Memo-12218) TEMPR 8: STEADY STATE THERMAL SIMULATION OF A SNAP REACTOR. Magee, P. M. (Atomics International, Canoga Park, Calif.). Oct. 28, 1966. Contract AT(11-1)-Gen-8. 27p. DTIE.

The digital program, TEMPR 8, simulates a SNAP reactor by dividing it into concentric rings of elements and performing detailed thermal calculations for a typical element in each ring. The code is being used to estimate beginning-of-life and end-of-life temperature profiles for S8ERS and S8DS. Other SNAP reactors, with up to 20 rings of elements, can be simulated. The utility of the program lies in the various options provided. TEMPR 8 is written in FORTRAN 4. Typical running times are 11 seconds for loading and 3 seconds per case execution. The option of CRT output for each ring is provided. (auth)

27787 (NAA-SR-Memo-12295) S8DS VARIABLY SPACED CORE, EVALUATION, AND DESIGN. Tromel, R. H. (Atomics International, Canoga Park, Calif.). Jan. 5, 1967. Contract AT(11-1)-Gen-8. 19p. Dep. CFSTI.

In the current S8DR, design flow is shaped by a baffle to optimize reactor performance. Pressure drop of the core is large due to the relatively high coolant velocities required. An alternate flow shaping technique involves varying the element spacing to obtain a flow area variation. When a uniform inlet and outlet pressure is provided for all channels, the flow rates are calculable from channel area relations. The variable area technique has been applied to the S8DR core and core pressure drop can be reduced. Implementation of the variable area core requires that S8DR lower plenum flow asymmetry be smoothed to obtain the uniform pressure condition. This flow shaping technique offers the potential of considerably reduced reactor pressure drop and an analytical method of designing flow shaping. (auth)

27788 (NAA-SR-Memo-12324) THERMAL ANALYSIS OF DROP-CALORIMETER DETERMINATION OF SNAP FUEL SPECIFIC HEATS. Magee, P. M. (Atomics International, Canoga Park, Calif.). Feb. 1, 1967. Contract AT(11-1)-Gen-8. 38p. Dep. CFSTI.

An analytical study of the proposed drop-calorimeter determination of SNAP fuel specific heats is summarized. The partial differential equations describing the transient temperature and hydrogen concentration distributions within a fuel specimen during testing are derived for numerical solution on a digital computer using the Thermal Analyzer Program (TAP-3). Results of the analysis are presented for various initial temperatures and compositions, pressure blowdown rates and calorimeter gas mixtures. A relatively slow blowdown to less than 1 atm H will permit the desired limits to be held on all delta and epsilon phase fuel specimens without encapsulation. The transient pressure distribution necessary to maintain constant H/Zr in a specimen can be determined from the cooldown curve of the specimen. Because of the long diffusion time constants the blowdown need only roughly approximate this ideal pressure transient. Blowdown to a partial vacuum can be avoided by the use of A–H mixtures; however, there is the possibility of stratification within the calorimeter. It should be noted that the irradiated fuel samples, of approximately one-fourth the mass of the test samples, will have faster cooldown characteristics necessitating more rapid pressure blowdowns. (auth)

27789 (NASA-CR-72190) SNAP-8 ELECTRICAL GENERATING SYSTEM DEVELOPMENT PROGRAM. Quarterly Progress Report, October 1–December 31, 1966. (Aerojet-General Corp., Azusa, Calif.). Jan. 1967. Contract NAS 5-417. 162p.

The development and testing of the SNAP-8 power conversion system is detailed. Specifically discussed are: component development; minor component test loops; PCS-1 phase IV; and technical support. (M.L.S.)

27790 (NASA-TM-X-1375) THEORY AND TESTING OF A SPACE RADIATOR SIMULATOR FOR A SNAP-8 GROUND TEST FACILITY. Schoenberg, Andrew A.; Bilski, Raymond S.; Thollot, Pierre A. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). May 1967. 46p. CFSTI.

Developmental work on a radiator simulator for the SNAP-8 simulator facility is given. The design of the simulator is discussed. Equations for coolant air control are derived by linear analysis. Results of the comparison of the experimental and analytical simulators are given; variations are discussed. Requirements for improved transient simulation are discussed. (M.L.S.)

27791 (NASA-TN-D-3979) FREQUENCY RESPONSE AND TRANSFER FUNCTIONS OF A NUCLEAR ROCKET ENGINE SYSTEM OBTAINED FROM ANALOG COMPUTER SIMULATION. Hart, Clint E.; Arpasi, Dale J. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). May 1967. 39p. CFSTI.

The dynamic response characteristics of the basic variables of a NERVA-type nuclear rocket engine system are presented. Frequency-response data, at four selected operating levels, were obtained from a detailed analog computer simulation. Frequency responses of thrust chamber temperature, chamber pressure, and reactor power to pertinent control or system variables are shown. Transfer functions that approximate the frequency responses are presented. The effect of reactor period on the reactor-power transfer function was investigated, and transfer functions are presented. These results provide essential information for control system analysis and design. The analytical models and assumptions used to develop the equations that represent the dynamics of nuclear rocket engine components are discussed. A set of specific equations that can be used in an analog computer simulation is presented. (auth)

27792 NUCLEAR CHARACTERISTICS OF LARGE REFLECTOR-MODERATED GASEOUS-FUELED CAVITY REACTORS CONTAINING HOT HYDROGEN. Herwig, Lloyd O.; Latham, Thomas S. (United Aircraft Research Labs., East Hartford, Conn.). AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 5: 930-7 (May 1967).

The change in critical mass of a large reflector-moderated gaseous-fueled cavity reactor due to the presence of hot H_2 gas in the cavity has been investigated using multithermal-group diffusion theory calculations that include up- and down-scattering between all groups. Critical masses of Pu-239 and of U-233 are presented for H_2 pressures between 0 and 1500 atm, for hydrogen temperatures of 20,000° and 60,000°K, for ratios of fuel radius to cavity radius of 1.0 to 0.45, and for two different reflector-moderator configurations. The thermal neutron flux distribution within the cavity is shifted by energy up-scattering collisions between thermal neutrons flowing into the cavity from the reflector-moderator and the hot H atoms. The relatively large thermal motion associated with hydrogen atoms at high temperatures gives rise to an increased probability for thermal neutron scattering. The changes in critical masses may be accounted for largely by the changes in the flux-weighted fuel region cross sections, even for fuels having 1/v cross-section dependences, since the radial neutron flux distribution and the neutron energy spectrum in the reflector-moderator are not strongly dependent upon cavity conditions. One scattering collision removes thermal neutrons from energy regions with high fission cross-section values up to regions with greatly reduced values. Critical mass increases are less drastic for ^{233}U than for ^{239}Pu because of the presence in ^{233}U of several fission resonances in the 1.0 to 10-ev energy range. The results of this study have been obtained using 18 neutron energy groups including 12 groups over the neutron energy range up to 3.06 eV. Calculated neutron flux spectra are presented to demonstrate the detailed nature of the calculational techniques and to show the changes in spectra which take place because of both hot hydrogen scattering and selective absorption of neutrons near the ^{239}Pu resonance at 0.3 eV. (auth)

27793 DESIGN, GROUND TEST AND FLIGHT TEST OF SNAP 10A, FIRST REACTOR IN SPACE. Johnson, Richard A.; Morgan, William T.; Rocklin, Sol R. (Atomics International, Canoga Park, Calif.). Contract AT(11-1)-Gen-8. Nucl. Eng. Design, 5: 7-21(Jan.-Feb. 1967).

The first nuclear reactor space power system, SNAP 10A, was successfully flight tested in April 1965. Included are a description of the reactor-thermoelectric system and the development program that preceded the flight. Special emphasis is given to the endurance test experience gained from the nuclear ground test system. The flight test is described in detail and the knowledge gained from the test is given. (auth)

Process Heat and Desalination Reactors

27794 (ORNL-4115) ABSTRACTS OF PAPERS, WATER AND DESALINATION INFORMATION MEETING, MARCH 28–29, 1967. (Oak Ridge National Lab., Tenn.). Mar. 1967. Contract W-7405-eng-26. 77p. Dep. CFSTI.

Abstracts from 26 papers on water research and desalination are included. The broad topics covered range from filtration and chemistry studies to pollution and purification, and, finally, to desalination. Various aspects of the nuclear desalination program are covered in some detail. (M.L.S.)

27795 APPLICATION OF REACTORS FOR DESALINATION. Baron, S. Atoomenergie Haar Toepass., 9: 57-63(Mar. 1967).

Studies have been conducted in the United States to determine the cost of desalinated water in dual-purpose plants. Multistage flash evaporator plant sizes from 10 mgd to 250 mgd have been examined. Water production costs are given for water at the site and the plant may be some distance from industrial areas where the product is needed. (J.C.W.)

Research and Test Reactors and Critical Assemblies

Refer also to abstracts 25935, 26295, 27564, 27739, and 27831.

27796 (AFRRI-TN-66-3) THE POSITIVE PERIOD METHOD OF CALIBRATING CONTROL RODS OF THE AFRRI–TRIGA REACTOR USING THE AFRRI DATA ACQUISITION SYSTEM. Schow II, Horace (Armed Forces Radiobiology Research Inst., Bethesda, Md.). Oct. 1966. 26p.

Control rods of the AFRRI-TRIGA reactor are routinely calibrated by the use of the inhour relationship between the stable positive period and reactivity. The Armed Forces Radiobiology Research Institute (AFRRI) Data Acquisition System (DAS) samples and digitizes the input voltage each 4.2667 seconds. Both the raw data and the stable period are typed out. The design stable period is between 30 to 70 seconds and from 18 to 22 incremented steps are necessary to calibrate the central transient rod. The core of the period calculation programming is board program BPNA (Function Generator) which is listed and discussed in detail. (auth)

27797 (BNWL-SA-1066-S) FFTF FUEL ELEMENT DESIGN. Cohn, P. D.; Bailey, W. J.; Lobsinger, R. J.; Millhollen, M. K. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Jan. 27, 1967. Contract AT(45-1)-1830. 4p. (CONF-670602-8). Dep. CFSTI.

From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif.

Design features aimed at satisfying the high flux requirements of the FFTF are described. Data and information are included on the core configuration, fuel element dimensions and arrangement, and heating rates. (J.R.D.)

27798 (GEAP-5340) NEUTRON SPECTRUM MEASUREMENTS IN A FAST PLUTONIUM ASSEMBLY, ZPR-III ASSEMBLY 48. Brown, P. S.; Weitzberg, A. (General Electric Co., Sunnyvale, Calif. Advanced Products Operation). Jan. 1967. Contract AT(04-3)-189. 28p. Dep. CFSTI.

The neutron spectrum has been measured in ZPR-III Assembly 48, a dilute, Pu-fueled fast reactor. At the core center, a proton recoil spectrometer was used to cover the energy range from 14 keV to MeV and resonance sandwich detectors were used to cover the range from 18.8 eV to 2.95 keV. In the U-238 blanket, a proton recoil spectrometer was used to cover the energy range from 4 keV to 1 MeV. (auth)

27799 (HW-61236(Suppl.7)) PLUTONIUM RECYCLE TEST REACTOR FINAL SAFEGUARDS ANALYSIS. SUPPLEMENT 7. ANALYSIS OF INCREASED POWER LEVEL. Nitteberg, L. J.; Wittenbrock, N. G. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). Dec. 4, 1964. Contract AT(45-1)-1350. 46p. Dep. CFSTI.

The Plutonium Recycle Test Reactor serves as a test facility for fuel elements. Increasing the reactor power level enables more rapid accumulation of fuel element exposure for the fuel element and processing studies provide more rigorous test conditions for the fuel. Safeguard analyses showed that the PRTR could be operated safely at a power level of 70 MW and that individual tube powers of 1800 kW present no serious risk. Safeguards analyses of operation of the PRTR at power levels up to 120 MW are presented. The nuclear excursion analyses were based on an 85 tube core. However, loss of coolant analyses were based on an assumed individual tube power of 1800 kW, and thus are independent of the total number of pressure tubes connected to the primary coolant system. This report documents the technical justification for changing the operating limit on the PRTR power level from a nominal 70 MW to a nominal 120 MW. (auth)

27800 (IDO-17138) THE EFFECTS OF COOLANT TEMPERATURE AND INITIAL POWER LEVEL ON THE EXCURSION BEHAVIOR OF A HIGHLY ENRICHED PLATE CORE IN SPERT III: EXPERIMENT AND ANALYSIS. Condit, C. M.; Scott, J. F.; Johnson, R. L. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Mar. 1967. Contract AT(10-1)-205. 119p. Dep. CFSTI.

Presented is the experimental data obtained from self-limiting power excursion tests performed on a highly enriched, stainless steel clad, plate core in the Spert III facility. The tests were initiated by step-insertions of reactivity with the reactor at power levels ranging from low power (10 W) to high power (28 MW) and with various combinations of other plant parameters: pressures (atmospheric to 2500 psig), temperature (ambient to 600°F), and flow (0 to 20,000 gpm). The reactivity insertions ranged from ≈ 0.4 to $\approx 1.2\$$, resulting in initial asymptotic reactor periods ranging from ≈ 1000 to ≈ 10 msec. The experimental data are correlated to show the effects of system temperature and initial power level on gross kinetic behavior. ART-04, a reactivity feedback model programmed for the computer to predict reactor transient behavior under operating conditions, is evaluated by comparing calculated and experimental transient data. The agreement between calculation and experiment is within the uncertainties associated with the data over the range of conditions considered. (auth)

27801 (IDO-17228) SPERT PROJECT QUARTERLY TECHNICAL REPORT, JULY-SEPTEMBER 1966. Taxelius, T. G. (ed.) (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Apr. 1967. Contract AT(10-1)-205. 65p. Dep.

An analysis of the uncertainties in the differential and integral control rod worth data was performed on Spert III E-core rods. Progress is reported on the Spert IV capsule driver core subassembly test program, and on design analysis of a core support structure to determine the upper limit of the loading that may be imposed on the structure during operation of the Power Burst Facility. The design and capabilities of the Spert data processing system intended for use in evaluating the course and consequences of reactivity accidents is described. (J.R.D.)

27802 (IN-1072) NEUTRON FLUX MEASUREMENT AT THE MTR BEAM HOLE HB-3. Myers, W. R.; Schmunk, R. E. (Idaho Nuclear Corp., Idaho Falls). May 1967. Contract AT(10-1)-1230. 20p. Dep.

Measurements of the thermal neutron flux from the radial beam hole HB-3 of the MTR show that a 1½ inch thick slab of light water will provide the optimum beam with respect to the total number of thermal neutrons and the ratio of thermal-to-fast neutrons. The source flux with this moderator is 2.9×10^{14} neutrons/cm^2/sec and the beam flux at the reactor shielding face is 1.2×10^{10} neutrons/cm^2/sec/steradian. The (In) Cd ratio is 3.78. The fast neutron and γ fields are very high and may restrict the use of HB-3 to out-of-beam facilities such as a triple-axis crystal spectrometer or a rotating crystal time-of-flight spectrometer. (auth)

27803 (NP-16727) REPORT ON SESSION 1965-1966. Wilson, H. W. (Scottish Research Reactor Centre, East Kilbride (Scotland)). Jan. 1967. 19p. (SRRC-14/67). Dep.

Activities of the Scottish Research Reactor Center are summarized. The experiments being conducted are each briefly discussed. Intended expansion of facilities is discussed. (M.L.S.)

27804 (ORNL-TM-1843) OAK RIDGE RESEARCH REACTOR QUARTERLY REPORT, OCTOBER, NOVEMBER, AND DECEMBER OF 1966. Tabor, W. H.; Hurt III, S. S. (Oak Ridge National Lab., Tenn.). Apr. 28, 1967. Contract W-7405-eng-26. 54p. Dep. CFSTI.

A summary of operations history is given for the ORR. Discussions of conditions which vary from the usual are: improvement of reactor and pool water, leakage in pool cooling pump suction line, contour measurements of the Al-Cd bowed shim rods, removal of one isotope stringer from service, and two experiment-related contamination releases. (M.L.S.)

27805 (PINSTECH/R.O.-02) THERMAL NEUTRON FLUX MEASUREMENT AND POWER DETERMINATION IN THE PAKISTAN RESEARCH REACTOR AT NILORE. Qazi, Muhammad Nuruddin; Qureshi, Muhammad Hafeez (Pakistan Inst. of Nuclear Science and Technology, Islamabad. Reactor Operations Div.). Nov. 1966. 17p. Dep.

The thermal neutron flux in the Pakistan Research Reactor at Nilore has been measured using the foil activation technique. Copper strips have been used for relative measurements whereas bare and cadmium covered gold foils were used for absolute determination. This information has been used to compute the reactor power. (auth)

27806 (SC-RR-66-2609 and Suppl.) FINAL SAFETY ANALYSIS: ANNULAR CORE PULSE REACTOR. Hasenkamp, A. (Sandia Corp., Albuquerque, N. Mex.). Nov. 1966. Contract AT(29-1)-789. 202p. Dep. CFSTI.

An analysis of the hazards associated with the proposed operation of the Annular Core Pulse Reactor (ACPR) is presented. The analysis includes descriptions of the reactor and facility, considerations of the reactor site in relation to hazards to operations personnel and to the public, evaluations of safety factors, and a description of supervisory practices and operating procedures. (auth)

27807 (SC-RR-66-2706) SPR II SAFETY ANALYSIS REPORT. Coats, R. L.; O'Brien, P. D. (Sandia Corp., Albuquerque, N. Mex.). Jan. 1967. Contract AT(29-1)-789. 77p. Dep. CFSTI.

The design and operation of the Sandia Pulsed Reactor II (SPR II), a fast burst reactor to be used in conjunction with a radiation effects research program, is given. The safety of the SPR II facility is analyzed with respect to the credibility of hypothetical accidents involving SPR II. (auth)

27808 (STI-DOC-10/71) RESEARCH REACTOR UTILIZATION. Summary Reports of Three Study Group Meetings. Technical Reports Series No. 71. (International Atomic Energy Agency, Vienna (Austria)). Feb. 1967. 99p. IAEA: $2.00; S 52,-; 14/2 stg; F Fr 9,80; DM 8,-.

A summary of results from three study groups is given. The topics cover: irradiation techniques at research reactors which include using the reactor as a source of radiation, low temperature irradiation techniques, medium and high temperature irradiation techniques, and irradiation techniques in very high flux reactors; research reactor operation and maintenance problems including operational procedures and commissioning programs, operational safety practice, physics support and maintenance aspects, chemistry support and maintenance, and engineering support and maintenance; and reactor utilization in the Far East including neutron diffraction spectrometry, irradiation techniques, radiation damage, hot atom chemistry, and radiation chemistry. (M.L.S.)

27809 (UCRL-4919(Rev.2)) THE LIVERMORE POOL TYPE REACTOR (LPTR). Radcliffe, John B. Jr.; Hill, Ernest E.; Cummings, Garth E. (California Univ., Livermore. Lawrence Radiation Lab.). Revised Jan 1967. Contract W-7405-eng-48. 54p. Dep. CFSTI.

The LPTR is a tank-type thermal, heterogeneous research reactor facility at the Livermore site of the Lawrence Radiation Laboratory (LRL). The light-water moderated and cooled reactor core generates a peak flux approaching $^{14}10$ n/cm^2-sec at an operating power of 3 MW. Access to the flux is provided by a variety of experimental facilities, including six horizontal beam tubes, two thermal columns, and two pneumatic tubes. The core of the LPTR contains about 3.8 kg of ^{235}U in fuel elements of the MTR type, arranged within a 5 by 7 element grid configuration which also provides space for Be reflectors on the north and south sides. Al is the primary structural material in the core and in the closed circuit cooling system. Magnetite concrete provides a compact biological shield. The reactor core is controlled by four B_4C shim safety rods and a stainless steel regulating rod, with conventional console control instrumentation. Safe containment through controlled leakage is emphasized in the reactor housing, an all-steel structure which is connected to adjacent labs and the control room by an air lock. (auth)

27810 STUDIES OF CERAMIC FUELS WITH THE USE OF FISSION GAS RELEASE LOOP. I. FISSION GAS RELEASE FROM UO_2-GRAPHITE MIXTURE DURING IRRADIATION. Yajima, Seishi (Tohoku Univ., Sendai); Kamemoto, Yuichiro; Shiba, Koreyuki; Handa, Muneo; Yamagishi, Shigeru; Fukuda, Takeshi; Takahashi, Yoshihisa; Tanifuji, Takaaki; Omori, Shunzo. J. Nucl. Sci. Technol. (Tokyo), 4: 164-70(Apr. 1967).

Fission gas release from a UO_2-graphite mixture was studied during irradiation with the use of the Fission Gas Release Loop in the JRR-3 reactor. The release rates of fission Kr and Xe increased proportionally with neutron flux ($6 \times 10^{10} \sim 6 \times 10^{12}$ n/cm$^2\cdot$sec) and exponentially with temperature (400 ~ 1,000°C). A burst of fission gas was observed when the specimen was abruptly heated to a higher temperature. These results can be explained by a mechanism whereby fission gas is trapped in defects created in graphite by fission fragments and released through annealing of the defects. (auth)

27811 NEUTRON IRRADIATION SYSTEM FOR 20^{0}K. Conte, R. R.; Dural, J. (Centre d'Etudes Nucleaires, Fontenay-aux-Roses, France). Rev. Phys. Appl., Suppl. J. Phys., 2: 1-6(Mar. 1967). (In French).

A neutron irradiation system located in the reactor Triton (swimming-pool type) at the Fontenay-aux-Roses Nuclear Center is described. The device consists of a cryostat with a liquid N_2 shield connected to a Philips PEH-100 cryogenerator—generating 300 W at 78°K for the first stage and 100 W at 20°K for the second stage. Both these elements, integral with the control and regulation panel, are supported on a carriage which can be moved in two directions perpendicular to one another, thus allowing exploration of different neutron fluxes. With this system, entirely automatic irradiations can be carried out in liquid N_2 or any other cryogenic fluid such as D or Ne. The device is so designed that the measurements (resistivity, elongation, traction, differential microcalorimetry when required) may take place in situ. However, it is possible to remove the samples at irradiation temperature in order to carry out laboratory measurements. To collect and analyze the information obtained from the samples investigated, a Hewlett-Packard numerical data system will be used in place of the conventional potentiometers. (auth)

27812 REACTOR WATER SOUND. Zajic, Vladimir (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Rez). Jad. Energ., 13: 1-3(Jan. 1967). (In Czech).

The construction and the functions of a reactor water sound are described. Data are included about the parameters of its operation and use. The water sound is used for static experiments during the investigation of water corrosion of materials and its inhibition in the radiation field of the WWR-S research reactor. (auth)

27813 EXPERIMENTAL STUDY OF THE BEHAVIOR OF FISSION PRODUCTS IN CASE OF ACCIDENT IN A SWIMMING-POOL REACTOR. Dadillon, J. Bull. Inform. Sci. Tech. (Paris), No. 112, 13-18(Feb. 1967). (In French).

In the estimation of nuclear risks connected with the running of a reactor an essential factor sometimes neglected because insufficiently known, is the knowledge of the type, amount and behavior of the contamination actually released inside the container in the case of an accident. In the special case of swimming-pool reactors the cooling fluid proves to be a very efficient barrier against contamination. Three experiments were carried out in the reactor CABRI, during which several fuel element plates were melted inside the core itself. (auth)

27814 THE REACTOR CABRI. Ailloud, J. Bull. Inform. Sci. Tech. (Paris), No. 112, 19-26(Feb. 1967). (In French).

A description of the CABRI reactor is given with a review of special equipment called CABRI PUISSANCE. Source of the improvements made on the original facility are also discussed. (M.L.S.)

27815 INSTRUMENTATION PROBLEMS WHICH ARISE IN REACTOR DYNAMICS. Tattegrain, A. Bull. Inform. Sci. Tech. (Paris), No. 112, 27-40(Feb. 1967). (In French).

The various measurement methods used for the tests performed on the Reactor CABRI and the characteristics of the measurements facilities are summed up. The limits imposed by these methods and by the electronic systems are more deeply investigated. (auth)

27816 REVIEW OF EXPERIMENTS ON REACTIVITY ACCIDENTS. Delchambre, Ph.; Millot, J. P. Bull. Inform. Sci. Tech. (Paris), No. 112, 41-56(Feb. 1967). (In French).

The results obtained from two similar shaped cores, though the channels' within fuel assemblies is different, are given. A first series of power bursts without flow has been performed with various initial temperatures. The second series of tests had the initial temperature at about 30°C, and the total coolant flow within the core varied. Results obtained with "OSIRIS Core" are far more exhaustive than with "SILOE Core": with "OSIRIS Core" flow rates have been measured, during transients, showing that, for periods shorter than 15 ms, a considerable amount of water is expelled out of the core, right at the power peak. (auth)

27817 EXPERIMENTAL STUDY OF LOSS OF COOLANT FLOW ACCIDENTS IN SWIMMING-POOL REACTORS. Delchambre, Ph.; Millot, J. P.; Tattegrain, A. Bull. Inform. Sci. Tech. (Paris), No. 112, 57-69(Feb. 1967). (In French).

The safety margins to be complied with when determining the power of a swimming pool reactor must be consistent with the behavior of the core under loss of coolant accidental conditions. An experimental investigation of such accidents has been carried on CABRI Reactor so as to get a better knowledge of those margins. As it is mentioned in the "Review of tests on reactivity accidents," two series of tests with OSIRIS- and SILOE-like cores have been performed. The coolant flow was stopped short either by turning off a pump or by closing a valve while the reactor was operated at the steady state power level. The behavior of the reactor of the power level and of the plates' temperatures have been measured then. Those tests will be used as an experimental check for a computer code as described in the chapter "Calculation of accidents in swimming pool reactors operated at power." (auth)

27818 CALCULATION OF POWER BURSTS IN SWIMMING POOL REACTORS WHEN THE COOLING SYSTEM IS NOT WORKING. Blanc, H.; Le Berre, F.; Millot, J. P. Bull. Inform. Sci. Tech. (Paris), No. 112, 95-112(Feb. 1967). (In French).

A model for computation of reactivity accidents in water reactors when the cooling system is not working is described. It may be applied to cores with plate-type or pin-type fuel. It takes into account the heating of the core, the moderator boiling and the Doppler effect. (auth)

27819 TIME OPTIMAL DIGITAL COMPUTER CONTROL OF NUCLEAR REACTOR. III. EXPERIMENT. Monta, Kazuo (Nippon Atomic Industry Group Co., Ltd., Kawasaki, Japan). J. Nucl. Sci. Technol. (Tokyo), 4: 51-62(Feb. 1967).

Time optimal control has been applied to a digital computer control system governing a research reactor (Toshiba Training Reactor). A program was developed for the control computer, with which actual experiments were performed. The results demonstrated the applicability of the various modern control theories for designing such systems. Discussion is first presented on some considerations required in realizing the results envisaged on the basis of a simplified model of the system. In view of the use of reactivity as variable representing the state of reactor system, a method has been developed that permits simple and accurate on-line calculation of the reactivity from changes in reactor power. The control is determined in the whole phase plane (neutron density vs reactivity), and is programmed with the use of appropriate simplifications and approximations. Experiments were first performed on a simulated system of the reactor and then on the actual reactor system. The results described cover experiments on steady state performance as well as transient performance with the reactor power varied in ranges extending to 2 decades. (auth)

27820 SHIELDING PROBLEMS ON THE REACTOR WWR-S BY INCREASING THE POWER FROM 2 TO 10 MW. Wetzel, L. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). pp 195-8 of Proceedings of the Second Symposium on Health Physics, Vol. I. Budapest, Publishing Group of the Central Research Institute for Physics, 1966.

See CONF-660948-(Vol.1).

Investigations in connection with preparations for increase of WWR-S power from 2 to 10 MW revealed that additional shielding is required at unused experimental beam tubes, and at an area between the movable plug and the floor of the reactor top. Thermal column additional shielding devices are also required. (J.R.D.)

27821 MEASUREMENT OF THE RADIAL NEUTRON TEMPERATURE DISTRIBUTION IN THE CORE OF THE TRIGA

Mk II REACTOR. Bensch, F.; Steuer, M.; Khorsandian, M. (Oesterreichische Hochschule, Vienna). Atomkernenergie, 12: 165-7(May-June 1967). (In German).

The temperature of a neutron field is determined using the ratio of the activation of a 1/v-foil to a foil, whose cross section has a resonance close to the thermal region. Mn as 1/v-foil and Lu as resonance detector are well suited for this purpose. The radial neutron temperature distribution in the core of the TRIGA Mk II reactor was determined during stationary and pulsed operation using thin foils of Mn-Ni- and Lu-Al-alloys. At two measurements the core center was filled with air, at one with water, as it is in normal operation. The accuracy of the neutron temperature determination is better than ±4°C. (auth)

27822 SODIUM HIGH TEMPERATURE LOOP IN THE SEIBERSDORF REACTOR CENTER. Rajakovics, G.; Schwarz, N. (Gebr. Boehler and Co. AG, Kapfenberg, Austria. Oesterreichische Studiengesellschaft fuer Atomenergie, Vienna). Atomkernenergie, 12: 179-82(May-June 1967). (In German).

A description is given of the Sodium-High-Temperature-Loop of Seibersdorf, which is designed for 800°C. Some special problems of the design are mentioned. The aims of the installation are described finally. (auth)

Reactor Components, Fuels and Accessories

Refer also to abstracts 26021, 26058, 26059, 26131, 26267, 26752, 26766, 26778, 26782, 26788, 26833, 26867, 26883, 26886, 26888–26891, 26899, and 26902.

27823 (AE-272) BURN-UP DETERMINATION BY HIGH RESOLUTION GAMMA SPECTROMETRY: FISSION PRODUCT MIGRATION STUDIES. Forsyth, R. S.; Blackadder, W. H.; Ronqvist, N. (Aktiebolaget Atomenergi, Stockholm (Sweden)). Apr. 1967. 21p. Dep.

The migration of solid fission products, in particular Cs and Ru, in high temperature oxide fuel can create a severe problem during the application of non-destructive burn-up methods employing gamma spectrometry, since ^{137}Cs is otherwise the most convenient long-lived burn-up monitor and ^{106}Ru can be used to distinguish between fissions in ^{235}U and ^{239}Pu. As part of an experimental program to develop burn-up methods, γ scanning experiments have been performed on slices of irradiated UO_2 pellets using a Li-drifted Ge detector. The usefulness of the technique for migration studies has been demonstrated by comparing the fission product distribution curves across the specimen diameters with the microstructure of the specimens after polishing and etching. (auth)

27824 (BAW-3714-2) GEL-ADDITION PROCESS CHEMICAL STUDIES. Quarterly Progress Report No. 2, October–December 1966. Dewell, E. H. (comp.) (Babcock and Wilcox Co., Lynchburg, Va. Atomic Energy Div.). May 1967. Contract AT(30-1)-3714. 40p. Dep. CFSTI.

Development of the Gel-Addition Process for preparing plutonia–urania mixed oxide fuels has been extended from study of the interaction of UO_2 gels and plutonium solutions to include development of equipment for firing to oxides and methods for examination of oxide microstructure. Improvements made in the preparation of UO_2 sols from uranyl nitrate include monitoring the reduction step ($U^{VI} \rightarrow U^{IV}$) to prevent nitrate co-reduction, and dispersal of the uranous hydroxide filter cake ultrasonically to a sol. (auth)

27825 (BNWL-413) THE 1107 MANUAL FOR PHYSICS CHAIN, A REACTOR ANALYSIS CODE. Kelley, E. L. Jr.; Marr, D. R. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr. 1967. Contract AT(45-1)-1830. 72p. Dep. CFSTI.

The UNIVAC 1107 PHYSICS CHAIN to generate neutron cross section data is described. (J.C.W.)

27826 (BNWL-SA-1042-S(Rev.A)) POTENTIAL OF ADVANCED FUELS FOR A FAST TEST REACTOR. Bailey, W. J.; Cohn, P. D.; Aase, D. T.; (and others) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Jan. 12, 1967. Contract AT(45-1)-1830. 5p. (CONF-670602-6(Rev.A)). Dep. CFSTI.

From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif.

The basis for comparison was an 800-liter, mixed-oxide-fueled core. Fuel cycle parameters and reactor core designs were investigated using an adaptation of the MIDAS computer code. Results indicate that mixed carbides and alloy fuels such as U–Pu–Zr offer potential advantages as advanced driver fuels for fast test reactors. Results of computer analyses of potential carbide and alloy fuels are tabulated. (J.R.D.)

27827 (BNWL-SA-1042-S(Rev.B)) POTENTIAL OF ADVANCED FUELS FOR A FAST TEST REACTOR. Bailey, W. J.; Cohn, P. D.; Aase, D. T.; (and others) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Jan. 12, 1967. Contract AT(45-1)-1830. 5p. (CONF-670602-6(Rev.B)). Dep. CFSTI.

From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif.

Potential advanced driver fuels for a fast test reactor were evaluated. These fuels consisted of seven carbide and eight alloy types. Fuel cycle parameters and reactor core designs were investigated with the MIDAS computer code. Fuel fabrication costs were examined. Predicted advantages of these fuels are presented. (M.L.S.)

27828 (BNWL-SA-1168) EXPERIMENTAL AND THEORETICAL METHODS USED FOR BURNUP ANALYSES AT BATTELLE NORTHWEST. Schmid, L. C.; Christensen, D. E.; Duane, B. H.; Liikala, R. C.; Matsen, R. P. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar. 14, 1967. Contract AT-(45-1)-1830. 35p. (CONF-670607-1). DTIE.

From International Conference on Physics Problems of Thermal Reactor Design, London, England.

An extensive program of experimentally determining and theoretically predicting the burnup behavior of Pu and U fuels is described. Methods which make use of specially developed least squares fitting programs are used to deduce effective cross section ratios to compare with theoretical predictions. One method permits a simultaneous fit of integrated burnup equations to experimental data and accounts for correlated measurement errors. The methods are applied to two types of fuels which contain Pu only and which have been irradiated in a D_2O moderated reactor. (auth)

27829 (GAMD-7242) GASA: A GENERAL LINEAR STABILITY ANALYSIS CODE. Baxter, A. M. (General Dynamics Corp., San Diego, Calif. General Atomic Div.). July 15, 1966. Contract AT(04-3)-167. 52p. Dep. CFSTI.

GASA evaluates the stability of a reactor, described by the linear reactor kinetics equations with temperature feedback, against perturbations about any operating power level. The code calculates and plots the transfer function between any state variable of the system and a given external forcing function or between any two state variables of the system. (auth)

27830 (GAMD-7535) FREVAP-8 CODE FOR ESTIMATING THE RELEASE OF METALLIC FISSION PRODUCTS FROM HTGR FUEL ELEMENTS. Zumwalt, L. R. (General Dynamics Corp., San Diego, Calif. General Atomic Div.). Dec. 8, 1966. Contract AT(04-3)-633. 39p. Dep. CFSTI.

The computer program FREVAP-8 is the formulation of a metallic fission product release code for two absorber regions. The equations used by the program are given. (J.C.W.)

27831 (LA-3671) DTF-BURN: A MULTIGROUP TRANSPORT THEORY BURNUP PROGRAM WRITTEN IN FORTRAN-IV. Prabulos, Joseph J. Jr. (Los Alamos Scientific Lab., N. Mex.). Jan. 20, 1967. Contract W-7405-eng-36. 93p. Dep. CFSTI.

The one-dimensional, multigroup transport burnup code, DTF-BURN, is described. Instructions for the use of the program are included, together with flow diagrams of the code, listings of certain subroutines, and the results of a test problem. The code can be used to compute the neutron flux distribution as a discrete-ordinates solution of the Boltzmann transport equation at the beginning of each specified time step. This calculated flux distribution is then used to determine the change in nuclide concentrations during the time interval. Nuclides considered in the burnup routine are ^{235}U, ^{236}U, ^{238}U, ^{239}Np, ^{239}Pu, ^{240}Pu, ^{241}Pu, ^{242}Pu, and FP, a pseudo fission product pair. The burnup differential equations may be applied to each region or to each point. (auth)

27832 (ORNL-P-2880) REACTOR NOISE ANALYSIS USING A PULSE TYPE DETECTOR. Trinko, J. Richard Jr.; Hanauer, S. H. (Tennessee Univ., Knoxville); Roux, D. P.; De Lorenzo, J. T. (Oak Ridge National Lab., Tenn.). Jan. 1967. Contract W-7405-eng-26. 6p. (CONF-670602-5). Dep. CFSTI.

From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif.

Studies of fluctuation of reactors using pulse detectors are presented. Data were collected under various conditions: to check detection efficiency, the counting loss was made negligibly small by a reduction of flux level; the effects of γ background were investigated by using a 42,000-curie ^{60}Co source; to determine counting losses, the neutron flux level was varied and the reactor was kept critical; a scaler discriminator system was used to check out the count-rate meter and discriminator system. A brief comparison of the pulse system and current system is given. (M.L.S.)

27833 (ORNL-P-3011) OPERATING EXPERIENCE WITH SYSTEMS DESIGNED FOR MANEUVERABILITY AND HIGH AVAILABILITY. Epler, E. P. (Oak Ridge National Lab., Tenn.). [1967]. Contract W-7405-eng-26. 9p. (CONF-670314-3). Dep. CFSTI.

From Liquid Metal Instrumentation and Control Symposium, Idaho Falls, Idaho.

A discussion of reactor control and safety systems available for high-performance in reactors is given. The type of instrumentation installed in the MSRE, the Aberdeen Pulse Reactor, and the HFIR is discussed. Operational experience gained from these and other instrumentation systems is evaluated. (M.L.S.)

27834 MEASUREMENT OF FAST FISSION RATIOS IN URANIUM CARBIDE RODS. Guardini, S.; Tassan, S.; Boeuf, A. (EURATOM-CCR, Ispra, Italy). Energ. Nucl. (Milan), 14: 217-27(Apr. 1967).

The results of measurements of fast fission ratios of ^{238}U to ^{235}U in isolated uranium carbide rods of varying diameter are given. The rods were exposed to a uniform thermal flux in several different moderating and reflecting media. The fast neutrons which were backscattered from the surrounding medium were shown to make a significant contribution to the fast fission ratio, the results being in good agreement with Monte Carlo calculations. (M.L.S.)

27835 AT1, STAGE OF STUDY PROGRAM FOR FRENCH LINE OF BREEDER. Amaury, Paul; Talmont, Xavier. Energ. Nucl. (Paris), 9: 113-19(Mar.-Apr. 1967). (In French).

The pilot-unit AT1 has a capacity of 150 kg per year and 1 kg per day of ceramics, and provides a mixture of decontaminated oxides to be re-employed. A very exhaustive study of the working conditions of the 30% TBP solvent in the high levels of irradiation, and of the associated devices, will be made. Mechanical treatment, leaching of ceramics, filtering, TBP solvent extractions, and ammoniacal precipitation will be optimized in view of realizing larger scale plants in the line of breeders. (auth)

27836 SINTERED URANIUM DIOXIDE AS REACTOR FUEL. Runfors, U. (Aktiebolaget Atomenergi, Stockholm). Svensk Kem. Tidskr., 79: 206-16(1967). (In Swedish).

A review is given of the requirements on sintered UO_2 as a fuel in water-cooled reactors. The effects of manufacturing is discussed. By variation of one parameter only, the temperature of reduction of UO_3 to UO_2, the properties of the UO_2-powders can be varied. Such properties, as specific surface area, determines the pressability and the sinterability of the powder and characteristics of the pressed and sintered pellets. The properties of UO_2 desired under reactor operations, economics of production, powder manufacturing methods, and pelletizing parameters are discussed. (auth)

27837 MECHANICAL COUPLING DEVICES AND NUCLEAR REACTOR FUEL ELEMENTS INCORPORATING THE SAME. Ince, George; Walmsley, Robert (to United Kingdom Atomic Energy Authority). British Patent 1,068,631. May 10, 1967. Filed Jan. 29, 1963.

A mechanical device for coupling generally cylindrical tubular members to rod-like members fitting inside the tubular member is described. The members are not disengaged by actions reverse to those used for engagement. The device is intended to be incorporated in fuel elements. (J.R.D.)

27838 DESIGN OF A 1000-MW SODIUM-HEATED STEAM GENERATOR FOR SUPERHEAT AND REHEAT. Gower, G. C. (Atomic Energy Commission, Chicago); Probert, P. B. Proc. Amer. Power Conf., 28: 109-16(1966).

The design of a high-pressure high-temperature steam generator is given. This generator is of the type required by the liquid-metal fast breeder reactor for economical nuclear power generation. A general discussion of the research and development work done on the generator is presented. (M.L.S.)

27839 MASS SPECTROMETRIC DETERMINATION OF BURNUP. Inoue, Kiyoshi; Taniguchi, Kaoru; Kobayashi, Tadao (Hitachi Ltd., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 4: 131-5(Mar. 1967).

A basic study was performed on the mass spectrometric determination of burnup for a UO_2 specimen irradiated in the HFR. It has been found that: by isotopic analysis of U, the contribution to burnup provided by the specimen through fissioning of ^{235}U was determined to be 4,370 MWD/T. The loss of ^{235}U through neutron capture was distinguished by the production of ^{236}U; the contribution to burnup of the specimen by fissioning of ^{239}Pu was determined to be 3,610 MWD/T from the excess formation of fission products such as ^{93}Zr, based on the known number of ^{235}U fissions; and the total burnup of the UO_2 specimen was taken to be 7,980 MWD/T, since no other isotopes of Pu were identified. (auth)

27840 TEMPERATURE DISTRIBUTION IN CYLINDRICAL FUEL-ELEMENT END CAPS AT UNSTEADY STATE. Ma, Benjamin M. (Iowa State Univ., Ames). J. Franklin Inst., 282: 9-19(July 1966).

The temperature distribution in bonded end caps of solid cylindrical reactor fuel elements at the unsteady state was determined analytically. Solution of the temperature distributions is expressed by products of Bessel functions and exponential functions with coupling relations between the fuel material and the end closures of the fuel element. A numerical example for a UO_2 dispersion fuel element with Zircaloy end caps is given. The results calculated for transient behavior of temperature distributions in the end caps indicated that: (1) for given end-cap length and material, the temperature distribution in the end caps tends to become uniform with time or Fourier number; (2) for a given mean heat transfer coefficient, the temperature distribution in the end caps depends chiefly on Fourier number; and (3) the temperature distribution for the end caps of various diameters is the same, if the time of heat conduction is proportional to the square of the diameter. Startup, shutdown, or fluctuation of instantaneous neutron flux during reactor operation may induce sudden temperature changes and produce severe thermal shock, cycling, and fatigue in the end-caps of individual fuel elements. These effects can seriously affect the corrosion temperature limit and cause structural defects at the interface of the fuel material and the end caps. (BBB)

27841 DIFFUSION OF FISSION PRODUCTS IN CERAMIC FUELS. Yajima, Seishi; Shiba, Koreyuki; Handa, Muneo. Sci. Rep. Res. Inst., Tohoku Univ., Ser. A, 18: Suppl., 231-7(1966).

Diffusion of Xe captured in graphite by fission recoil has been studied over a wide range of fission product concentration in graphite. The release of Xe from graphite could not be interpreted by a simple diffusion model, but was controlled by fission-fragment-induced defects where fission Xe was trapped. The chemical state of fission I_2 released from ceramic materials has also been investigated by using thermochromatograph. It became clear that fission I_2 diffused out of ceramic materials was not elementary I_2, but was iodide of fissile material. (auth)

27842 IMPROVED HIGH-PRESSURE VESSEL CONSTRUCTED OF PRESTRESSED CONCRETE. Hay, John Douglas (to Sir Robert McAlpine and Sons Ltd.). British Patent 1,066,387. Apr. 26, 1967. Filed Apr. 14, 1965.

A pressure vessel comprises a monolithic concrete body including a cylinder and closing end slabs with prestressed tension cables constituting an array distributed about the circumference of the body. The individual cables of the array are disposed within passages preformed in the concrete. The passages conform to parts of right and left hand helices about the axis of the vessel, and each cable embraces only a part of the circumference of the vessel. The ends of the cables extend through the end slabs, and the tensioned cables are anchored at both ends by anchorages located at the ends of the vessel. The concrete monolith is formed with an annular extension of the wall of the cylinder projecting axially beyond the periphery or adjacent part of the outer surface of the adjacent end slab, and the ends of at least some of the helical passages in the concrete for the tensioned cables extend through the concrete of the annular extensions. The anchorages for the tensioned cables in these passages are located at the surface of the annular extensions. (B.L.M.)

27843 FUEL ELEMENT. Turner, Richard F.; Nehrig, Dean A.; Leon, Harry I. (to U. S. Atomic Energy Commission). U. S. Patent 3,318,779. May 9, 1967.

Nuclear fuel elements for use in a high-temperature gas-cooled reactor are described. The fuel elements have a plurality of separate longitudinal refractory material body sections containing packed beds of nuclear fuel particles. (AEC)

27844 PRESSURE TUBE FOR NUCLEAR REACTORS. Ziegler, A. (to Siemens-Schuckertwerke Aktiengesellschaft). Canadian Patent 755,717. Mar. 28, 1967. Priority date Sept. 15, 1962, Germany.

A pressure tube is described consisting of two coaxial tubes having annular end pieces with a third small tube separating the first two and maintaining the gap between them. It may be disposed like a helix or in some other manner. Reliability is claimed in separating two different media at different temperatures and pressures using a minimum amount of material so the neutron absorption is minimized. Little welding or soldering is required. (F.S.A.)

27845 IMPROVEMENTS IN OR RELATING TO NUCLEAR FUEL ELEMENT FABRICATION. Lloyd, Henry (to United Kingdom Atomic Energy Authority). British Patent 1,069,277. May 17, 1967. Filed Nov. 16, 1964.

Fabrication of metal clad ceramic fuel elements by an improved method is described. The ceramic fuel is loaded into the fuel can and disintegrated by ultrasonic vibration or thermal shock. Intimate fuel–cladding contact results promoting efficient heat transfer. (J.R.D.)

27846 IMPROVEMENTS IN OR RELATING TO A PROCESS FOR THE PREPARATION OF URANIUM DIOXIDE. (to Norton Co.). British Patent 1,062,285. Mar. 22, 1967. Priority date June 6, 1963, United States.

A process for producing stoichiometric, coarsely crystalline UO_2, comprises melting a composition having an O-to-U ratio of 3 or less, passing an inert gas, such as Ar, through the mass and to purge the system, passing H_2 through the mass to convert it to stoichiometric UO_2, and cooling the mass to an ambient temperature under an inert gas. The product obtained is essentially free of contamination by N, C, and elemental U. (P.G.C.)

27847 IMPROVEMENTS IN OR RELATING TO DRILLING MACHINES. Berry, Jean Louis; Darras, Raymond; Fritz, Georges (to Commisariat a l'Energie Atomique). British Patent 1,060,252. Mar. 1, 1967. Priority date Sept. 10, 1963, France.

Equipment is described for drilling irradiated tubular fuel containers for the purpose of recovering gaseous fission products. The machine comprises a driving motor, drill-holding arbor, lock chambers, movable carriage, and support cradle, all contained in a three-unit radiation protection shield. (P.G.C.)

27848 FLUID CONTROL VALVE. (to Atomic Energy of Canada Ltd.). British Patent 1,068,302. May 10, 1967. Priority date May 11, 1964, United States.

A fluid control valve is described that is particularly applicable as a dump valve for a liquid-moderated reactor. The valve casing defines a passageway with a valve gate mounted in the passageway. The valve is operated between a completely closed and a completely open position by a pair of cooperating magnet elements comprising an electromagnet and an armature mounted one on the valve gate and one on the casing. (B.L.M.)

27849 SYSTEM FOR REMOTELY POSITIONING A MOVABLE MEMBER. Aubert, Michel; Fortin, Guillaume; Gugenberger, Rene; Martin, Roger; Rouge, Pierre (to Commissariat a l'Energie Atomique). British Patent 1,069,070. May 17, 1967. Priority date Jan. 7, 1965, France.

A remote control system for positioning a movable member having motor means for moving it over a path within an inaccessible enclosure includes fixed markings along the path, optical means carried at least in part by the movable member for scanning the markings, and means for transmitting images of the markings and for converting the images into corresponding signals. Memory means compares the signal from the member passing the markings with a stored signal and when the signals coincide, an output is applied to the motor means to arrest it on its path. The system is applicable to refueling operation in a nuclear reactor. (B.L.M.)

GENERAL

27850 (BNL-992) EARLY HISTORY OF ASSOCIATED UNIVERSITIES AND BROOKHAVEN NATIONAL LABORATORY. Brookhaven Lecture Series No. 55. Ramsey, Norman F. (Brookhaven National Lab., Upton, N. Y.). Mar. 30, 1966. Contract AT(30-2)-Gen-16. 20p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

The history of the Associated Universities and of the Brookhaven National Laboratory is discussed. The initial concept is also described. (B.G.D.)

27851 (LA-3685) ERROR BOUNDS ON NUMERICAL SOLUTIONS OF DIRICHLET PROBLEMS FOR QUASILINEAR ELLIPTIC EQUATIONS. Frank, Thurman G. (Los Alamos Scientific Lab., N. Mex.). Aug. 1966. Contract W-7405-eng-36. 150p. Dep. CFSTI.

Thesis. Submitted to Univ. of Texas [Austin].

Let R be a closed, bounded, simply connected region in the plane. Let P denote the Dirichlet problem $Au_{xx} + 2Bu_{xy} + Cu_{yy} = G$ on R in which A, B, C, G depend on x, y, u, u_x, u_y. It is assumed that A, B, C satisfy a uniform ellipticity condition and a condition which enables uniqueness of the solution of P to be established by means of a maximum principle; also, it is assumed that R and the coefficient functions are such that $u \in C^4$ on R. Several finite difference analogues of P are studied which use, essentially, central differences except near the boundary. One such scheme uses the method of Bramble and Hubbard to treat the term $2Bu_{xy}$. It is shown that the solutions of the finite difference analogues converge, with decreasing mesh width h, to the solution of P. Moreover, the error is $O(h^p)$ with p either one or two depending on which particular combination of difference equations in the interior and at the boundary of R is used. (auth)

27852 (NP-16666) UKAEA LIST OF PUBLICATIONS AVAILABLE TO THE PUBLIC. Cumulation No. 11, January-December 1966. (Atomic Energy Research Establishment, Harwell (England)). Jan. 1967. 129p. Dep. mn. CFSTI $3.00 cy, $0.65 mn. HMSO 18s. 0d.

Details are given of unclassified reports, translations, journal papers, books, pamphlets, and patent specifications issued by the United Kingdom Atomic Energy Authority during 1966. Details of availability are given, including microcopies. One thousand eight hundred and thirty seven references are listed, and an author and report serial index provided. (UK)

27853 (RFP-839) WEIGHING HEAVY LOADS TO AN ACCURACY OF 0.001 PERCENT. Pippin, Clarence A. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). May 2, 1967. Contract AT(29-1)-1106. 11p. Dep. CFSTI.

A study was performed to determine the accuracy attainable using a load cell and a readout technique. The data were obtained on a 200 pound Toledo Precision Load Cell. Equally reliable data are to be expected for 50,000 pounds on larger models of the same type of transducer. Operating the system for one week in a constant ambient temperature and with regulated line voltage, a total deviation of 0.001% was noted. For percentages over 18% of full load the total variation of readings amounted to 0.004% of full load in an ambient temperature that was uncontrolled. (auth)

27854 (RISO-M-513) BESKRIVELSE AF INTERFACEUDSTYR TIL PDP8 OG ANALOGIMASKINEN. (Description of the Interface Equipment for the PDP8 Digital Machine and Our Analog Computer). Christensen, P. la Cour (Danish Atomic Energy Commission, Risoe. Research Establishment). Jan. 1967. 27p. (In Danish). (R-1-67). Dep. mn.

A description of the interface equipment for the PDP 8 digital machine and one analog computer is given. A short description of the hardware including the structure of each unit is given, and the instructions are explained. Some standard subroutines used in hybrid computation are described e.g., input and output of analog voltages, setting of digital potentiometers, interrupt administration, number conversion and input-output via the typewriter. (DENM)

27855 (RT-ING-(66)16) APPLICAZIONI DEL CONTROLLO DIGITALE DIRETTO. (Applications of Direct Digital Control). Roselli, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1966. 20p. (In Italian). Dep.

A survey of on-line digital computer applications for direct control of plant variables was made. Technical and economic characteristics of direct digital control and conventional analog controllers are compared. (tr-auth)

27856 (SC-CR-67-2555) INVESTIGATION OF ORGANIC THERMOCHROMIC MATERIALS. West, B. D. (New Mexico Univ., Albuquerque. Dept. of Chemistry). Mar. 1967. Contract AT(29-1)-789. 9p. DTIE.

The synthesis of 3,5-diphenyl-4-hydroxyimidazole by two distinct routes yielded thermochromic products that were identical by all available chemical and physical criteria. In attempts to determine what causes this compound to be thermochromic, several of its analogs were prepared. However, none of these proved to be thermochromic. (P.C.H.)

27857 (SC-DC-67-1402) APPLICATION OF DISLOCATION DYNAMICS TO IMPACT INDUCED DEFORMATION UNDER UNIAXIAL STRAIN. Butcher, B. M.; Munson, D. E. (Sandia Corp., Albuquerque, N. Mex.). Apr. 1967. Contract AT(29-1)-789. 29p. (CONF-670513-1). Dep. CFSTI.

From Colloquium on Dislocation Dynamics Conference, Seattle, Wash.

The extent to which several mathematical representations of dislocation motion can be used to describe elastic wave attenuation in 4340 steel was investigated. It was found that the Gilman relation described the experimental data quite well, although the values of the parameters were strongly influenced by the choice of the input stress condition. A linear velocity relationship also described the experimental data adequately, but not as precisely as the Gilman function. The thermal activation function showed marked discrepancies. A simple analysis of the plastic wave in 4340 steel showed that the plastic strain at a given position in the material developed at a nearly constant value of the maximum shear stress. The magnitude of this stress was about the same as the amplitude of the elastic wave at that position. Dislocation velocities appear to be small compared to the shear wave velocity, so that the large plastic strain rates calculated from the experimental records indicated considerable dislocation multiplication. A linear relation between plastic strain rate and plastic strain at constant stress was observed; but the data are not over a sufficient range to test the hypothesis that the dislocation density relation can be taken as a function of strain alone. Parameters for the elastic wave attenuation in 1060 aluminum were computed using the Gilman function. This information and a dislocation multiplication model based only on plastic strain were used to make a parametric study of the plastic wave profile. Qualitative agreement was obtained for certain aspects of the wave. The model did not account for material deformation close to the impact plane; the calculations predicted much greater relaxation behind the elastic precursor than was observed. (auth)

27858 (SC-DC-67-1540) SUMMARY OF THE STABILITY AND AXIAL FORCE DATA OBTAINED DURING THE SANDIA TEST PROGRAM ON THE STANDARD HYPERVELOCITY BALLISTIC MODELS HB-1 AND HB-2. Millard, W. A. (Sandia Corp., Albuquerque, N. Mex.). [1964]. Contract AT(29-1)-789. 15p. (CONF-670511-1). Dep. CFSTI.

From 27th Supersonic Tunnel Association Meeting, Tullahoma, Tenn.

A summary of the static stability and axial force data recorded in the Sandia 18-inch Hypersonic Wind Tunnel at Mach 5.3, 7.5, and 11.4 on the STA standard models HB-1 and HB-2 is presented. These data were compared with available data previously obtained at Arnold Engineering Development Center. Only relatively minor discrepancies were noted in the comparisons of the data from the two facilities. (auth)

27859 (SC-DC-67-1731) SINUSOIDAL STEADY-STATE CHARACTERISTICS OF MULTIELECTRODED PIEZOELECTRIC DEVICES. EerNisse, E. P.; Holland, Richard (Sandia Corp., Albuquerque, N. Mex.). Apr. 1967. Contract AT(29-1)-789. 11p. (CONF-670415-1). Dep. CFSTI.

From Frequency Control Symposium, Atlantic City, N. J.

A tractable technique for analyzing the circuit behavior of mechanically free, multielectroded, three-dimensional, piezoelectric devices was developed by describing the steady-state operation by a stationary Lagrangian. It has been shown that the approximation techniques of variational calculus can be used to evaluate either the short-circuit or the open-circuit resonant modes of piezoelectric structures. The calculus of variations is used to show how to obtain an admittance matrix for a device once the short-circuit resonant modes are known, or, how to obtain an impedance matrix for a device once the open-circuit resonant modes are known. To illustrate these concepts, numerical results are presented for the admittance matrix of dot-ring electroded piezoelectric ceramic discs with comparable diameter and thickness dimensions. (auth)

27860 (SC-DC-67-1744) PROJECTED TOLERANCE ZONE CONCEPT. Nicovich, P. A. (Sandia Corp., Albuquerque, N.

Mex.). Mar. 1967. Contract AT(29-1)-789. 13p. (CONF-670603-2). Dep. CFSTI.

From 6th Meeting of the International Standards Organization and Transportation Corps Drawings, Moscow, USSR.

The projected tolerance zone concept as a new and proven method for controlling the position and attitude of threaded holes is recommended for further study and consideration. It has been shown that the conventional method of applying positional tolerances to threaded holes does not always ensure proper assembly of parts or guarantee interchangeability. In this case, the precept of allowing total variation of threaded hole axis within a tolerance zone located below the mating surface is detrimental to design intent. Interferences can occur which do not allow the engaging fastener to enter the threaded hole at assembly. By simply projecting the tolerance zone a specified height above the mating surface, these interferences can be carefully avoided. (auth)

27861 (SC-DC-67-1745) THREE PLANE CONCEPT. Dell, R. O. (Sandia Corp., Albuquerque, N. Mex.). Apr. 1967. Contract AT(29-1)-789. 21p. (CONF-670603-1). Dep. CFSTI.

From 6th Meeting of the International Standards Organization and Transportation Corps Drawings, Moscow, USSR.

The Three Plane Concept of making engineering drawings more mathematically and geometrically precise specifies on a drawing the relationship of the part and its features to a reference framework of three mutually perpendicular planes. This method enables the designer to establish a common origin for measurements for all users in the manufacturing and inspection operations thereby ensuring a uniform interpretation as they execute their individual functions. The method facilitates the use of the drawing wherever programming is required for the manufacture of a part by numerically controlled equipment. (F.S.)

27862 (SC-DR-67-298) RF INTERMODULATION CHARACTERISTICS OF VHF TELEMETRY PREAMPLIFIERS AND RECEIVERS. Jeske, H. O. (Sandia Corp., Albuquerque, N. Mex.). May 1967. Contract AT(29-1)-789. 23p. Dep. CFSTI.

Tests were conducted on ten preamps and six receivers to quantitatively determine their linear operating range. The range of linear operation was determined by the measurement of, or the effects of, intermodulation products that were produced by the simultaneous application of two input signals. Measurements were made at a frequency equal to twice the frequency of one signal source minus the frequency of the other signal source. Preamp test results indicated that their dynamic range varies from approximately 46 to 70 db. It was found, under the best conditions with some receivers, that their proper operation was prevented by the presence of two signals that were less than 30 db larger than the desired signal. The two interfering signals were located well outside the rated −60 db bandwidth of the receiver. (auth)

27863 (SC-RR-65-260) AN EXPERIMENTAL INVESTIGATION OF THE CONTINUOUS PENETRATION OF A BLUNT BODY INTO A SIMULATED COHESIONLESS SOIL. Colp, John L. (Sandia Corp., Albuquerque, N. Mex.). Dec. 1965. Contract AT(29-1)-789. 76p. Dep. CFSTI.

Constant velocity experiments were performed to investigate the penetration of a blunt body into a two-dimensional granular target medium having no cohesion. The mechanism of continuous penetration at constant velocity was compared with present soil ultimate strength theory (used to predict the failure of a statically loaded footing). The study was also designed to determine how penetration velocity and penetrator width affect resistance to continuous penetration and to determine if the Prandtl–Terzaghi formula for bearing capacity could be used to compute the resistance to penetration of a projectile into a granular cohesionless material. The target material used in the experimental study consisted of many thousands of precision ground steel rollers of 3 diameters ($^1/_{16}$, $^3/_{32}$, and $^1/_8$ inch) stacked in a target tank having one transparent face. One-, two-, and three-inch wide penetrators were used at four different, constant velocities. Both the unit and the total load on the penetrator decreased as the velocity of penetration increased. Unit loads on the penetrator decreased as penetrator width was increased. The Prandtl–Terzaghi static bearing capacity formula gave reasonable results when used to compute the resistance into the target material; however, this agreement may have been merely a coincidence with the particular region of penetration velocities, depths, and penetrator widths investigated. Similar studies of penetration are discussed and referenced. (auth)

27864 (SC-RR-66-676) RELATIONSHIP BETWEEN THE EQUATION OF STATE AT HIGH PRESSURES AS DETERMINED FROM ULTRASONIC DATA AND FROM SHOCK DATA. Ruoff, Arthur L. (Sandia Corp., Albuquerque, N. Mex.). June 1966. Contract AT(29-1)-789. 19p. Dep. CFSTI.

Methods of analyzing ultrasonic data of single crystals at high pressures are described. Attention is given to the physical meaning of these data. The exact values of the bulk modulus and approximate values of the other elastic constants appropriate to the polycrystalline aggregate can be obtained. Ultrasonic data give a linear relationship between the bulk modulus and pressure under fairly wide conditions. On the basis of Murnaghan's equation of state a MacLauren expansion for $\Delta V/V_0$ versus P is obtained. This is a very slowly converging series. It is usual to analyze data in terms of $\Delta V/V_0 = AP - BP^2$ whenever a least mean square analysis is used to obtain A and B. These values of A and B are often compared to the respective terms in the MacLauren series expansion. Because of the slow convergence of that series, it is shown that it is far more appropriate to compare the experimental coefficients with the respective coefficients which are the best least squares fit to the Murnaghan equation of state. (R.C.K.)

27865 (SC-RR-67-143) SWAP-7: A STRESS-WAVE ANALYZING PROGRAM. Barker, L. M. (Sandia Corp., Albuquerque, N. Mex.). Apr. 1967. Contract AT(29-1)-789. 126p. Dep. CFSTI.

The SWAP-7 computer program for solving stress-wave problems in one-dimensional strain is described in detail. Typical computer run times are 1 to 5 minutes per problem. The program handles both hydrostatic and elastic-plastic materials, and can incorporate such effects as work hardening, changes in elastic constants and yield strength with pressure and internal energy, and spall at a given tensile stress. The program output provides the stress, strain, material velocity, and internal energy at all positions and times covered in the problem. An impact problem and a radiant energy deposition problem are included as examples, and an appendix gives the derivations for using Grüneisen equations of state in the program. (auth)

27866 (SC-TM-64-528) METHOD FOR ESTIMATING THE DRAG COEFFICIENT OF A TUMBLING CIRCULAR CYLINDER. Randall, Duane E. (Sandia Corp., Albuquerque, N. Mex.). May 1964. Contract AT(29-1)-789. 14p. Dep. CFSTI.

A method is presented for estimating an effective drag coefficient for a tumbling circular cylinder in hypersonic flow. (auth)

27867 (SC-TM-67-42) DETERMINATION OF ISENTROPES FOR ARBITRARY EQUATIONS OF STATE. Bertholf, L. D. (Sandia Corp., Albuquerque, N. Mex.). Apr. 1967. Contract AT(29-1)-789. 19p. Dep. CFSTI.

A method and a computer program are described for the calculation of isentropes in the pressure-density plane. The accuracy of the program is examined by using an ideal gas equation of state to analytically determine the isentrope. This analytical solution is compared to the numerical solution for the ideal gas. A method and a portion of the theoretical background are given for a material that has a straight line shock-velocity/particle-velocity relation, and satisfies the Gruneisen Equation of State with a constant Gruneisen Ratio-density product. A specific example of this method is included for aluminum. (auth)

27868 (SC-TM-67-50) EFFECT OF A POLYSULFIDE RUBBER ON THE ELECTRIC STRENGTH OF AN EPOXY RESIN. Boots, C. W. (Sandia Corp., Albuquerque, N. Mex.). Apr. 1967. Contract AT(29-1)-789. 10p. Dep. CFSTI.

Electrical strength test specimens of the Rogowski contour were made with two epoxy resins and a polysulfide rubber. With Epon 828/Z cured epoxy-polysulfide rubber composite, breakdown strength was approximately the normal value while for SRIR-polysulfide composite there was a degrading effect of the polysulfide on the composite strength. This could have been caused by breakdown initiation in the polysulfide or a chemical surface effect of the polysulfide on the polymerization of the SRIR. (auth)

27869 (SC-TM-67-185) A STUDY OF THE OUTPUT OF A Q-SWITCH LASER SYSTEM. Hawley, J. G.; Landry, M. J.; Limestahl, K. W.; Lochner, J. R.; Portlock, J. M. (Sandia Corp., Albuquerque, N. Mex.). Apr. 1967. Contract AT(29-1)-789. 30p. 30p. Dep.

The stability test of the output of a TRG-104 laser is reported. Several components of a Q-switch laser system could cause instability in the output energy, variation in the output energy to the flashlamp, nonconsistent temperature variation in the active medium (the ruby), or other changes in the optical cavity. Results of the tests are applicable to any Q-switch laser system in general, especially those which use a spinning roof-prism switch. (auth)

27870 (SC-TM-67-214) ANALYSIS OF THE DESPINNING OF A PRECESSING AND NUTATING RIGID BODY. Perdreauville, Farrell J. (Sandia Corp., Albuquerque, N. Mex.). Apr. 1967. Contract AT(29-1)-789. 32p. Dep. CFSTI.

If a spin-stabilized body is coning at the instant that despin action begins, it becomes necessary to determine whether the despin mechanism will perform in the same manner as it would were the body not coning and what the motion of the body will be after the despin mechanism has functioned. An analysis of flyweight-despin of a coning body and of the motion of the body after the flyweight mechanism has spent itself is described. (auth)

27871 (SC-TM-67-235) RESPONSE OF AN ELASTIC CYLINDRICAL SHELL TO A TRANSVERSE, ACOUSTIC PULSE. Forrestal, Michael J. (Sandia Corp., Albuquerque, N. Mex.). Apr. 1967. Contract AT(29-1)-789. 24p. Dep. CFSTI.

A long cylindrical shell is subjected to a plane acoustic wave whose front is parallel to the axis of the shell. Response formulae for the dilatational and first flexural modes for a step pressure pulse are developed. These formulae are in terms of elementary functions and can easily be used as influence coefficients to determine, by means of Duhamel integrals, the response produced by an arbitrary pressure pulse. (auth)

27872 (SCL-DR-66-75) THERMOCHEMICAL FLOW PROGRAM (TCFP). Emery, A. (Sandia Corp., Livermore, Calif. Washington Univ., Seattle). May 1967. Contract AT(29-1)-789. 98p. Dep.

A general program for computing gas-flow properties for several typical problems (such as shock waves) is described. The program is composed of a series of subroutines which generate thermodynamic data, determine allowable chemical species, compute equilibrium compositions, and calculate flow-state properties All calculations are based on the assumption of ideal gases and chemical equilibrium. (auth)

27873 (SCL-DC-67-22) EFFECT OF SOME VARIABLES ON THE THROWING POWER AND EFFICIENCY OF COPPER PYROPHOSPHATE SOLUTIONS. Dini, John W.; Johnson, Herman R.; Helms, John R. (Sandia Corp., Livermore, Calif.). Apr. 1967. Contract AT(29-1)-789. 30p. (CONF-670606-1). Dep. CFSTI.

From American Electroplaters Society National Convention, Dallas, Tex.

A study of some of the factors involved in Cu pyrophosphate plating was undertaken to determine the effects of these factors on throwing power and cathode efficiency. Plating-bath constituents investigated included Cu, pyrophosphate, NH, ortho phosphate, and inorganic salts. The effects of variations in pH, temperature, agitation, and current density were also investigated. All throwing power data were obtained in Haring cell modified to provide controlled agitation at both cathodes. This resulted in deposits much more representative of those produced in industrial baths. (auth)

27874 (SCL-DR-67-32) FINITE-DIFFERENCE SOLUTION OF THE BOUNDARY-LAYER EQUATIONS. Chenoweth, D. R. (Sandia Corp., Livermore, Calif.). May 1967. Contract AT(29-1)-789. 48p. Dep. CFSTI.

A general computer program was developed to analyze steady boundary layers in compressible, multicomponent, and chemically reacting flows. Both molecular and turbulent transport are included, with the turbulent eddy coefficients left somewhat arbitrary due to the lack of dependable models. The boundary-layer equations, transformed by means of the Howarth–Dorodnitsyn transformation, are solved using the Crank–Nicolson finite-difference procedure and the tridiagonal algorithm. (auth)

27875 (SCL-TN-67-33) FORTY-CHANNEL PORTABLE FM DATA ACQUISITION SYSTEM. Porter, J. D. (Sandia Corp., Livermore, Calif.). Apr. 1967. Contract AT(29-1)-789. 3p. Dep. CFSTI.

A portable 40-channel FM (frequency modulation) system, consisting of voltage-controlled oscillators, signal conditioners, amplifiers, and test equipment, is described. The system was designed to provide an efficient means for acquiring transducer data at locations not easily serviced by existing data centers. The FM system, which is 29 × 51 × 73 inches in size, can be moved about easily within a building, but should be transported between locations by a truck or forklift to prevent vibration damage. The system is capable of recording 20 channels of either strain gage, bridge-type, or swept resistance-type transducer data, or combinations of these types; and 20 channels of either voltage monitors, current monitors, or accelerometer data from charge amplifiers, or combinations of these types. The portable system, designed for simplicity of operation rather than maximum versatility, can be quickly set up and calibrated. By limiting the versatility, the setup time and operator error have been considerably reduced. (auth)

27876 (UCID-15138) AN AUTOMATIC, VARIABLE VOLUME, GAS DISPENSER. Crawford, R. W. (California Univ., Livermore. Lawrence Radiation Lab.). Aug. 30, 1965. Contract W-7405-eng-48. 5p. Dep. CFSTI.

An automatic variable-volume gas dispenser was developed for calibration of vacuum analytical systems. It stems from a requirement for the automatic injection of standard gas in amounts ranging from ~0.030 to 3.000 cc STP. (B.G.D.)

27877 (UCRL-13266) PROJECT WISP: TASK 4-1B. Final Technical Report, October 25, 1965–May 25, 1966. Golian, Serge E. (Philco Corp., Newport Beach, Calif. Aeronutronic Div.). Contract W-7405-eng-48. 156p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

For Lawrence Radiation Lab., Univ. of California, Livermore.

Various aspects of the problem of sensing the position or regime changes of an object from within the object itself are discussed. The regimes of interest are underground, surface, and above the surface. The most promising solutions are the sensing of the cosmic radiation, the magnetic field vector, the atmospheric pressure, and the gravitational field. (J.H.M.)

27878 (UCRL-50171) INTRODUCTION TO THE THEORY OF SIGNAL-TO-NOISE ENHANCEMENT. Brubaker, Thomas A. (California Univ., Livermore. Lawrence Radiation Lab.). Jan. 5, 1967. Contract W-7405-eng-48. 28p. Dep. CFSTI.

The fundamental methods of statistical analysis used to recover signals from noise are presented. Emphasis is on simple time- and sample-averaging techniques. Three primary methods of signal-to-noise enhancement are considered: filtering, integration, and averaging of repeated samples. References to the basic literature are included. (auth)

27879 (UCRL-50210) FORTRAN PROGRAM (TEMCAL) FOR CALCULATION OF HUGONIOT TEMPERATURES, ISOTHERMS, AND RELEASE ADIABATS FROM HYDRODYNAMIC DATA. Walker, Franklin E. (California Univ., Livermore. Lawrence Radiation Lab.). Mar. 27, 1967. Contract W-7405-eng-48. 30p. Dep. CFSTI.

A FORTRAN program (TEMCAL) was written to calculate Hugoniot temperatures from experimental hydrodynamic data. The program also derives a least-squares fit to the data, calculates isotherms and release adiabats, and gives graphic presentations of data and solutions. (auth)

27880 (UCRL-50250) PUBLISHABLE GRAPHS BY COMPUTER: A FLEXIBLE, EASY-TO-USE PROGRAM FOR THE CALCOMP PLOTTER. Terrall, J. R. (California Univ., Livermore. Lawrence Radiation Lab.). Apr. 15, 1967. Contract W-7405-eng-48. 32p. Dep. CFSTI.

This program produces inked graphs from any subroutine that merely defines y as a function of x. It was written in FORTRAN II for the CALCOMP plotter, but it requires no knowledge of the plotting routines. The pen may be stopped at will, by input, for changing the width of lines in order to achieve emphasis and artistry. Labels and titles, punched on input cards, are automatically centered, or started at a particular point. Also, they can be titled by an input number. The program has been found extremely useful, not only in producing publishable graphs, but also in making working drawings for testing various formulas, and for comparing with curves that already exist (in journals, for example). Because of the flexibility in size, a plot can be made to exactly the same scale as an existing drawing and then the two can be compared by making use of the semitransparency of the plotting paper. (auth)

27881 (Y-1576) CORRECTING FORM ERRORS IN NUMERICALLY CONTROLLED MACHINED, POINT-DEFINED, SURFACES OF REVOLUTION. Broome, F. H.; Anderson, P. J. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). May 15, 1967. Contract W-7405-eng-26. 14p. Dep. CFSTI.

Repeatable errors in parts manufactured by numerically controlled, single-point machining processes can now be corrected. By applying empirical corrections, developed from inspection data, to the contour description, form errors in the inner contour of an approximately four-inch-radius hemispherical copper assembly were reduced from 600 microinches total variation (± 300 microinches from the desired dimension) to 200 microinches total variation (+120 microinches, −80 microinches from the desired dimension). The method can be readily applied to the APT programming system and is relatively inexpensive since, by using it, it is not necessary to rewrite the entire APT program. (auth)

27882 USA(2). (Univ., Goettingen, Ger.). Schriftenreihe Bundesmin. Wiss. Forsch., Kernenergierecht (Munich), 12: 1-311(1966). (In English and German).

A summary is presented of U. S. legislation on atomic energy enacted in sessions through those of the 88th Congress. Information is included concerning organization of the Atomic Energy Commission, security, Atomic Energy communities, radiation protection, labor laws, mining laws, transport laws, patent laws, nuclear ships, and international cooperation. (J.R.D.)

27883 TRENDS IN THE DEVELOPMENT OF ATOMIC SCIENCE AND TECHNOLOGY. Emelyanov, Vasily (Academy of Sciences, Moscow). At. Energy Rev., 4: Commemorative Issue, 81-4(Dec. 1966).

A brief account is given of the events which have taken place in world science and technology in connection with the peaceful atom since fission of the atomic nucleus was achieved more than a quarter of a century ago, and the trends of future development are considered. The basic fields of research dealt with and the practical work to implement and apply the results thereof, relate to nuclear power, radioactive waste disposal, the generation of power by nuclear fusion, the discovery of new analytical methods of detecting elements, research on high energy particles, the use of radiations and radioisotopes in industry for process control, in instrument manufacture, geology and archaeology, food preservation by radiation, nuclear ship propulsion plants, the use of nuclear energy to correct the course of spacecraft, and the desalination of salt water. (auth)